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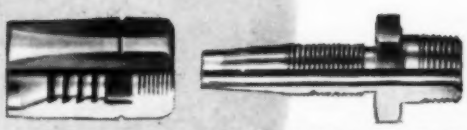

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FRONT COVER: A Link-Belt Speeder shovel, equipped with "Speed-O-Matic" hydraulic controls, in operation on a typical road construction job. This type of control is described in the story by Frank J. Strnad in this issue. Turn to page 6.

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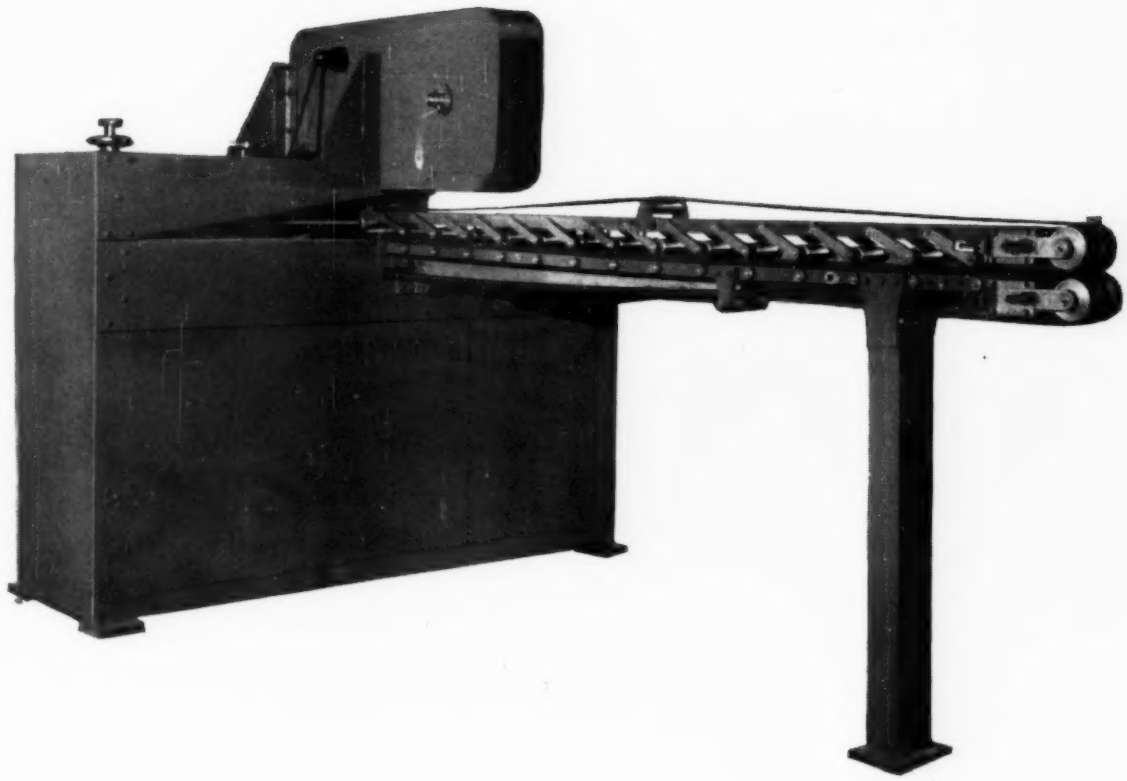

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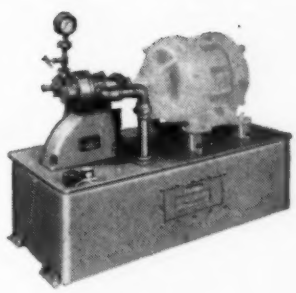

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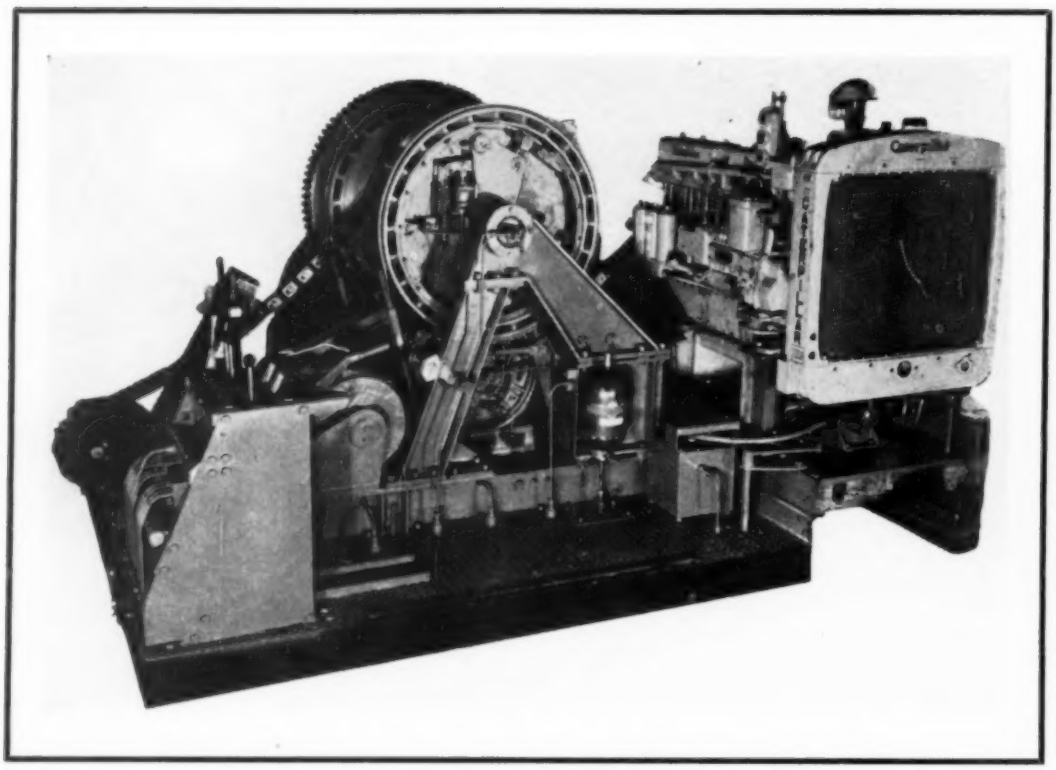


Fig. 1. General view of hydraulically controlled machinery on upper revolving deck of diesel powered Link - Belt Speeder shovel, illustrating control valves mounted in operator's panel, engine driven vane type pump under radiator and oil sump tank on platform. Also shown are the bladder type accumulator, hydraulic rotating joints in ends of revolving hoist and swing clutch shafts and hoist clutch band actuating cylinder within the clutch.

THE LAYMAN usually thinks of power shovels as clumsy brutes requiring brawn rather than skill for efficient operation. This concept is no doubt derived from observation of some such machines built in years gone by. However, a review of equipment as now produced by the shovel and crane industry will disclose a high degree of modernization, not only in general machinery construction but in the means of controlling its operation. The modern shovel that is powered by an internal combustion engine will be found equipped with hydraulic, air, vacuum or at least mechanical booster controls to facilitate operation at maximum speed through the operator's shift. This applies especially to the larger machines where operator fatigue reflects more noticeably on production records.

Many years ago, Link-Belt Speeder Corp. realized that consideration of the operator was necessary in order to utilize the benefits of advanced design and higher speeds then being incorporated in power shovels. Accordingly, improved mechanical boosters, air and other means of control were considered. While all such control mediums possessed some advantages, hydraulics offered the best possibilities in speed of operation, simplicity of design, transmission of large forces through compact mediums, relative immunity to climatic conditions and minimum adjustment attention required. A pilot model built some 14 years ago and subsequent production machines demonstrated the original assumption correct.

Considerable improvements were incorporated in component units since Link-Belt Speeder Corp. pioneered the first modern hydraulically controlled shovel; however, the basic accumulator circuit remained fundamentally the same. Up to a few years ago, relatively constant accumulator pressure was maintained by means of a differential relief valve on the discharge side of pump. However, resultant oil heating problems necessitated a

By Frank J. Strnad
Hydraulic Engineer
Link-Belt Speeder Corp.
Cedar Rapids, Iowa

TO POWER SHOVEL-CRANES

The experience of a pioneer user of hydraulic controls for power shovels demonstrates the advantages of such controls in simplicity and compactness of design, in operating speeds, in wide ambient temperature conditions and in minimum maintenance.

pump of minimum delivery capacity for circuit requirements and excessive oil viscosity variations, internal leakage or other circuit inefficiencies affected proper operation. When component units are maintained at top efficiency, such circuit design however proves to be quite satisfactory, as demonstrated by the many setups in operation.

Tracing the present unloading valve circuit diagram employed, which eliminates the heating problems and permits use of a larger capacity pump, oil is drawn from the sump tank and forced into a high pressure accumulator and remainder of the closed system. When pressure in the accumulator develops to approximately 1025 psi, the unloading valve automatically relieves the pump of any additional work by directing pump delivery back to the sump tank at practically atmospheric pressure. An integral check valve in the unloader prevents reverse flow from accumulator and system. When the accumulator pressure decreases to approximately 825 psi through operation of the machine, the unloading valve again directs oil flow from the pump to the system until it is charged, at which time it again repeats the cycle of relieving the pump. A safety relief valve, set at a higher pressure than the unloading valve, is employed to protect the circuit against damage in the event the unloading valve sticks in the loading cycle.

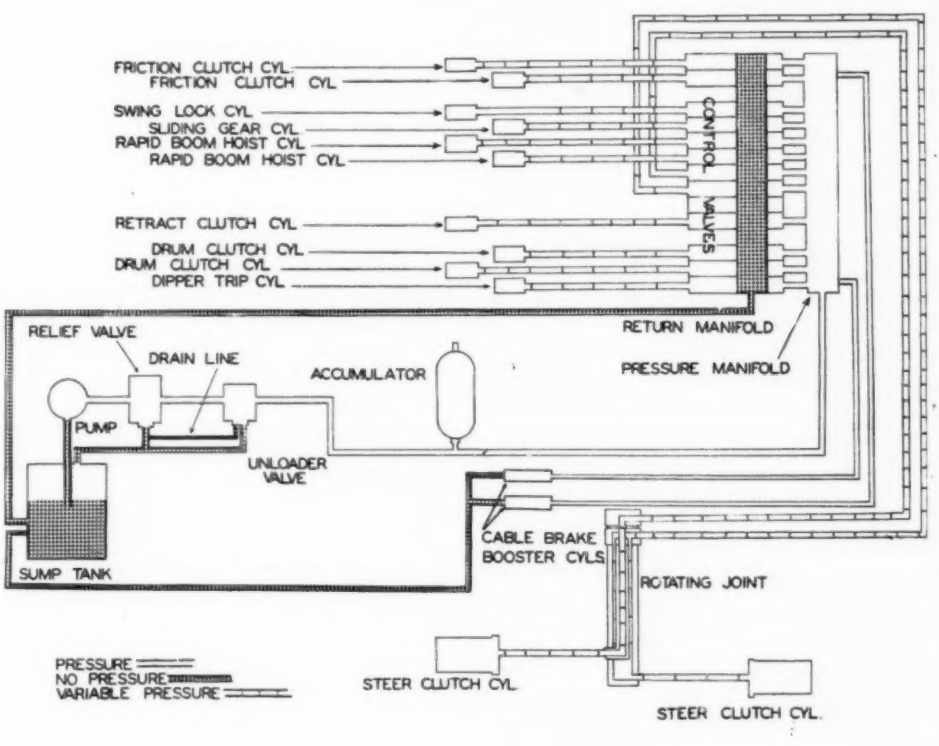


Fig. 2. Schematic of hydraulic control system on shovel-crane. In order to simplify diagram, each control valve is shown serving one actuating cylinder. Actually, some valves serve multiple cylinders such as used on friction clutches, retract clutch and automatic boom hoist brake tapped to rapid boom lowering circuit.

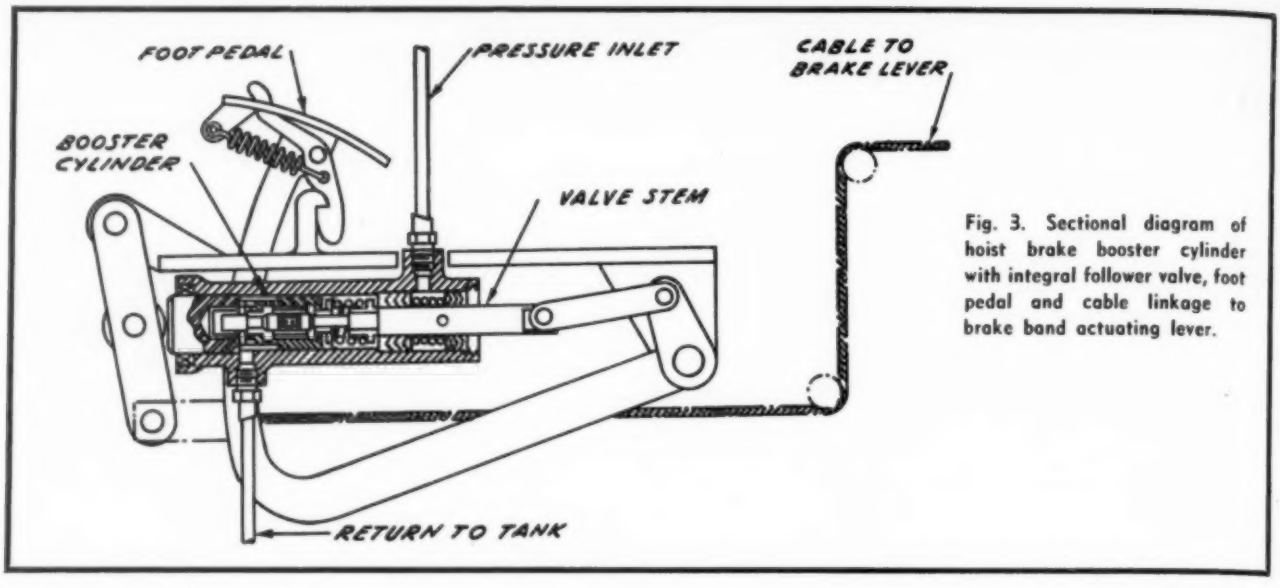


Fig. 3. Sectional diagram of hoist brake booster cylinder with integral follower valve, foot pedal and cable linkage to brake band actuating lever.

Experience with Accumulators

Smooth operation of this circuit depends considerably on an efficient accumulator and three types were tried or used prior to the present bladder type. The first accumulator employed utilized a stratum of glycerin as a separator between the system oil and the nitrogen charge. Since this arrangement proved unsuitable for mobile equipment subject to considerable motion, it was discarded in favor of a spring loaded piston. The relatively high volume of stored energy, however, required a large spring, resulting in a bulky and cumbersome unit. The third accumulator used, and many of which are now in satisfactory operation, was of the piston type loaded with an inert gas. In addition to the lighter weight, the bladder type accumulator employed in current production has the advantage of eliminating static friction usually found in piston type units. Such friction, if excessive, effects efficient operation of the unloading valve.

Types of Valves

Since this circuit is primarily employed as a means of actuating and controlling various friction clutches, simultaneously or independently, the conventional selector valves usually found in hydraulic equipment are unsuitable. The special valves designed for this circuit are of three-way construction, closed center, of the pressure regulating type, tapped to a common pressure manifold, and distribute oil to the various cylinders at pressures directly proportional to the position of the operator's hand lever. Oil pressure in cylinders reacts through the valves against control levers, transmitting proportional resistance of the load to the operator. This feature provides the desired ability to "feel" the load as in conventional mechanical controls.

Other features which had to be considered in the design of these valves included simplicity of construction and low maintenance; ability to control and sustain pressures in cylinder lines in infinite increments from zero to full accumulator pressure; and provisions to operate several valves simultaneously, at various pressures without interferring with or affecting operation of other valves in the control bank.

Practically all actuating cylinders are of the single acting spring return type, permitting the utmost in simplicity of design. Packing cups generally employed are of molded construction with sufficient flare to provide a positive seal at low and high pressures. With the exception of larger sizes, cups are not fastened to pistons but are permitted to float, minimizing crowding and pinching tendencies of the conventional design. Many years of field service have proven this method of construction highly efficient. More recently, "O" rings have been employed as seal mediums with promising results.

Booster Cylinders

Smoothness of operation and reliability are of primary importance in hoist brakes on equipment of this type. In order to retain such features of strictly mechanical brakes but eliminate the excessive forces necessary for operation, special hydraulic booster cylinders and integral control valves were designed for use in conjunction with cable actuated units. Operator foot pedals are connected directly to brake bands through control cables and in the event of hydraulic pressure failure, the operation remains strictly mechanical, requiring additional foot pressures but retaining safety features of the conventional design. In normal operation however, the hydraulic booster cylinder assists in application of the brake, the degree of such boosting action being determined by cable resistance.

The metering valve, which serves as a link between foot pedal and control cable, is cou-

pled in the booster cylinder as a follower and regulates oil flow to and from booster as required by foot pedal motion. The construction of this mechanism is also such that booster is inactive on light loads, and provides boosting action only as required by resistance to braking action.

Selection of Oil

Equipment of this nature is often subject to the most severe operating conditions under adverse temperatures or climates and selection of proper hydraulic oil is therefore more important than in the conventional machine tool or similar hydraulic circuit. Many years of actual field service indicate high quality mineral turbine oil of paraffin base most suitable for this particular circuit. Although extreme temperature conditions may require a lighter or heavier grade, a majority of operations are satisfied with an oil of about 180 SSU at 100 F. Heavier oils are also employed to minimize effects of excessive internal leakage on older machines or where component units are slightly worn due to presence of abrasive dirt.

In view of the varying temperature conditions under which shovel-cranes must operate, oil possessing high resistance to change of viscosity is of primary importance and a viscosity index of at least 90 is therefore desirable. It is also interesting to note that while the oil found most satisfactory is not of the "low pour point" type, it responds more readily with less pump cavitation tendencies under sub-zero conditions than many of the conventional hydraulic oils. Extensive field service would indicate such oil has less resistance to flow even when slightly congealed than many products in the fluid stage.

Since rapidly changing ambient temperatures generally result in condensation within the oil supply tank, another important oil requirement is that of a high demulsibility factor. Failure of oil to resist emulsification, and lack of chemical stability, in outdoor application results in rapid formation of gums and corrosion detrimental to smooth action of the component units.

While the primary intention of hydraulic controls on power shovels and cranes was to provide easier and faster operation and thereby utilize benefits of advanced machinery design, the application of such controls permitted further improvements in mechanisms operated. As an example, crawler steering mechanism and travel brakes were made semi-automatic, the travel or "digging" brakes applying whenever steer and travel clutches are disengaged. Available hydraulic forces permitted a swing and travel clutch design in which lining pressures are more uniformly distributed and lining life therefore increased considerably. The pressure regulating valve limits available forces in actuation of the various functions and therefore serves as an overload safety for most of the machinery.

Other advantages derived from such controls are elimination of many moving parts necessary in the older, mechanical design and a considerable reduction in the number and frequency of mechanical adjustments. The summary of all such advantages results in considerably increased productive capacity, in many cases 25 percent to 50 percent over comparable size machines equipped with the older mechanical controls.

Fig. 4. Typical rigid shoe friction clutch actuated by twin hydraulic cylinders. Oil is supplied to cylinders through rotating joint in end of shaft.

Fig. 5. Typical single acting, spring return actuating cylinder with floating cup.

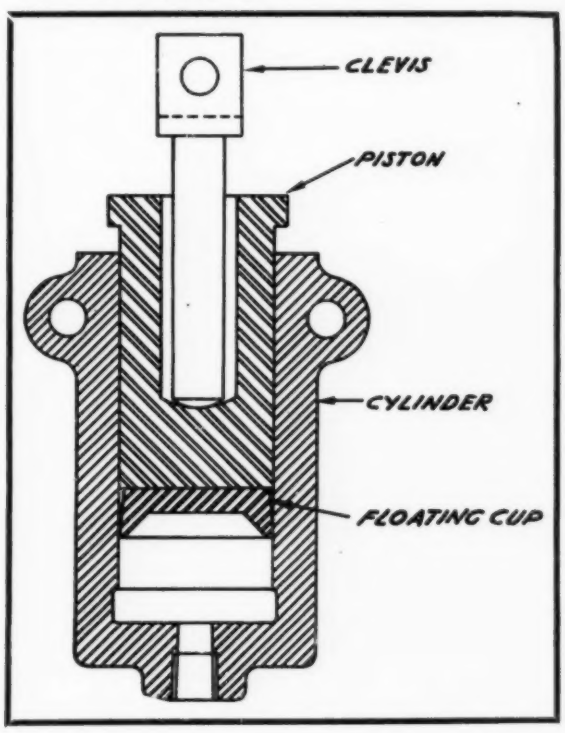
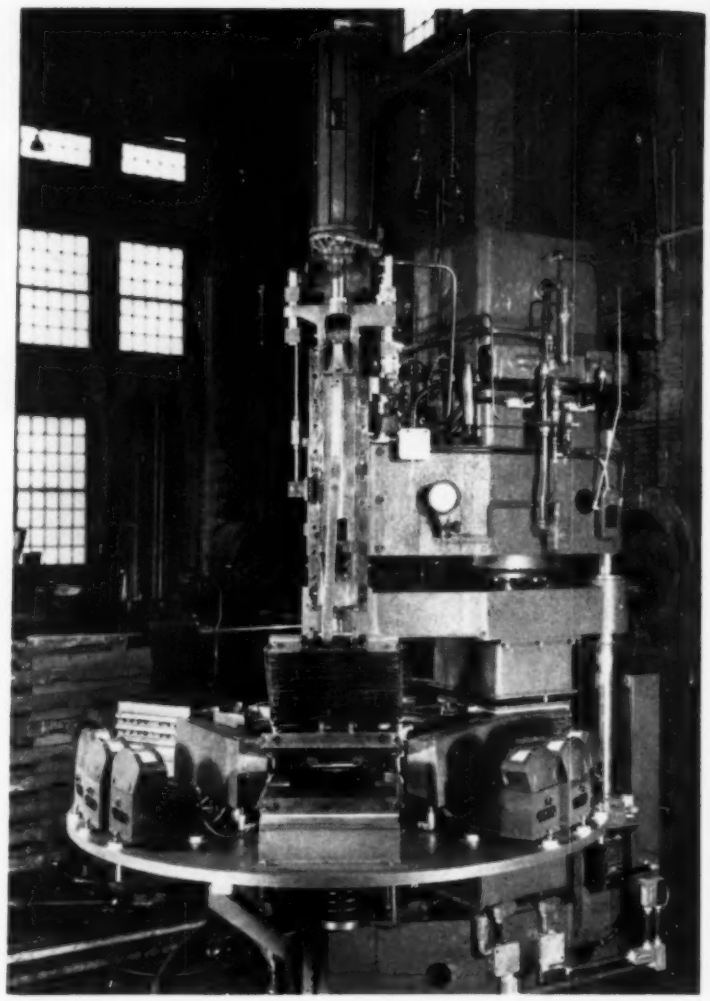


Fig. 1. The dial feed press with the mold platens at the loading station fully open. The air hoist is at its uppermost position and the lower platen is ready for loading.



The use of a hydraulic system and two auxiliary air cylinders in a special dial type molding press to speed work cycles, provide safe automatic operation, facilitate loading, unloading and cleaning and to reduce overall machine investment.

"BOOK" MOLDING BY FLUID POWER

By EARL CANNON
Chief Engineer
Elmes Engineering Works
American Steel Foundries
Chicago, Illinois

A DIAL FEED molding press to mold insulation is one of our more interesting recent developments. In this development it was necessary to meet and solve a number of problems presented by the special handling conditions imposed by the product. The finished machine incorporates one hydraulic circuit and two air circuits. A brief discussion on the design and operation of the press may be of interest to production executives as well as to design and application engineers.

The press is designed to mold insulation. Since it is necessary to clean the molds for each cycle and to wipe the product before inserting them manually, considerable time is required for loading. This would normally necessitate three presses for the production required. Obviously, it is very advantageous to have a single machine permitting loading and curing simultaneously.

Since the preliminary heating of the material does not have to be done under pressure, a three-station dial feed is provided. The work is loaded and unloaded in one station, the preliminary heating is done in the next station, and the third station is the pressing station. The capacity press is 100 tons.

The three stations are mounted, equidistant, on the dial or rotary table. Rotation is provided by an electric motor which operates through a suitable gear reduction. One of the two air circuits brakes the speed of this motor to assure accurate indexing. This method of braking has been found to be more accurate and more flexible in adjustment than other types of motor brakes.

Perhaps the most interesting design feature of the dial press is the method used for loading and unloading the armature bars. If all the bars were placed in one mold, the depth of the mold, from front to back, would

make the loading, unloading and cleaning operations extremely inconvenient. An arrangement similar to a multiple-opening hot plate press would introduce costly design complications in lifting and separating two or more levels of mold platens. The answer is the use of a two-level mold in which the lower mold, the intermediate mold and the top mold are all hinged so as to form what may be called a "book".

In the loading and unloading station, the book is in line with an air hoist. This hoist is provided with a swinging hook which is pivoted in a trunnion attached to the lower end of the cylinder piston. In the lowest position of the air hoist and with the press open, the hook is held clear of the book, permitting rotation with its dial. After the dial table has been indexed into a new position, the downward movement of the press releases the hook so as to engage a handle on the uppermost leaf of the book. The air hoist is then operated to move upward until the air hoist slide engages a stop. This opens the upper layer of dies to permit removal of the work and cleaning.

After the upper level has been cleared of material, a pushbutton releases the stop and the air hoist continues to its uppermost position, opening the lower level of the book. The completed work in this level is then removed, the dies cleaned, and the new work inserted. The air hoist is then lowered until it comes against a stop in the approximate mid-position of the down stroke, closing the lower section of the book, but keeping the upper section open for loading. After the upper section is loaded, the stop is released again by pushbutton and the air hoist continues down to close the book entirely.

At the end of the timed pressing cycle, the upward movement of the main slide of the press releases the hook from the book, ready for the next rotation of the dial.

The hydraulic circuit is built into the head of the machine above the press station. The compact assembly contains its own 7½ hp, 1160 rpm motor, vane type two-stage pump of 2½ gpm at 2000 psi capacity, double solenoid operated, open center, 4-way valve, directly operated counterbalance check or holding valve and a balanced piston type relief valve. The top mounted reservoir is equipped with a water counterflow type oil cooler, gauge and air breather.

The air hoist is mounted vertically over the table. A cushioned air cylinder of 6 in bore and 29 in stroke operates the swinging hook.

A second air cylinder of 2 in bore and 1 in stroke is used as a brake in decelerating the motor that indexes the dial. Since all thermostats and the electric contactors for them are mounted on the dial they must be protected against the shock of starting and stopping the indexing dial. The rate of deceleration of the indexing motor is controlled by adjusting the air pressure.

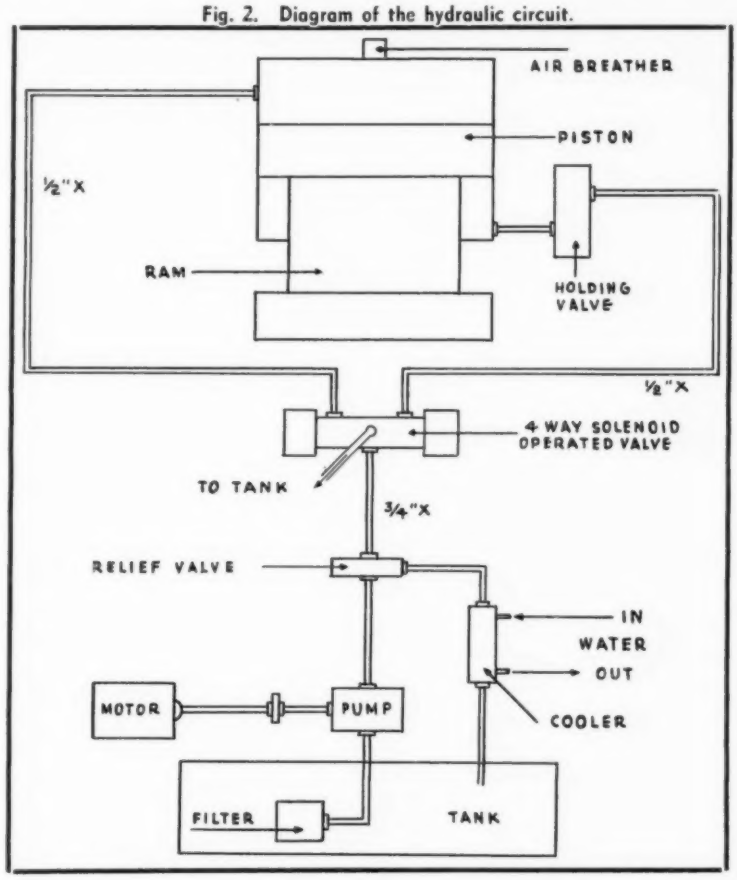
The dial is provided with a small amount of float, being supported on a heavy spring (Figure 1). For this reason, during rotation, the lower surface of the dial clears the bed of the press. When the pressure of the ram is applied in closing the press, the dial supporting spring compresses slightly, permitting the dial plate to rest solidly on the bed of the press, removing all load, due to pressure of the press, from the rotating mechanism of the dial.

The press slide operates in automatic sequence with the movement of the dial.

As suggested previously the dies are heated in the second or intermediate station position.

The general plan of the design and installation of the hydraulic system for the press above the ram, common in large presses, is used to advantage on the dial feed press. The advantages of the use of standard elements and parts, accessibility for service and maintenance, economy of space and convenience for the operator add up to our goal—a satisfied customer.

Fig. 2. Diagram of the hydraulic circuit.



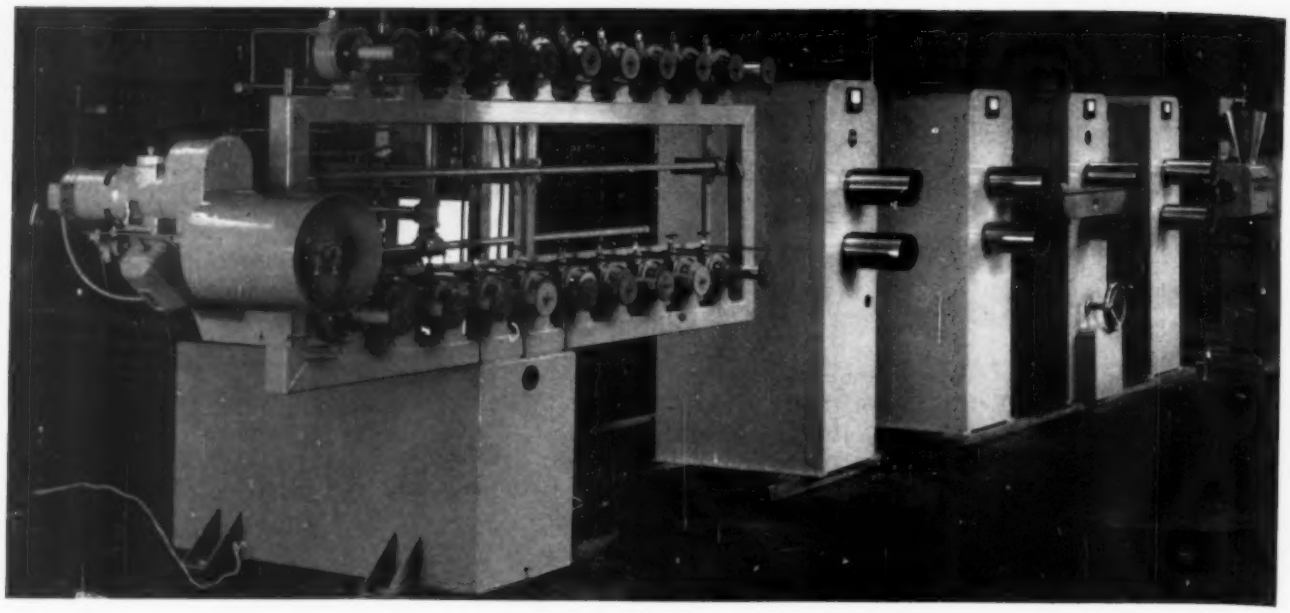


Fig. 1. The general view of the spooler (left), the orientation machine and the extruder. The cold and hot water baths are not shown.

PRECISION SPOOLING OF PLASTIC FILAMENTS

The utilization of a pump and cylinder for driving and traversing multiple spool heads in a plastic filament winding operation has eliminated troublesome mechanical devices, made speed and torque control positive and simple and provides flexibility for handling many types of synthetic and natural materials.

A HYDRAULICALLY DRIVEN and traversed spooler for the precision winding of plastic monofilaments is in operation in a number of large textile mills. All spools of the 20-spindle unit are driven and traversed from a single low pressure pump and cylinder; individual valves on each spool control both speed and torque. While the unit was designed for use with polythene and polyethylene extruded filaments, every type of plastic filament now extruded commercially has been spooled successfully.

The rotor gear type pump (250 psi for continuous operation) is directly connected with a 1200 rpm motor by flexible coupling. Branch tubing from the trunk pressure supply line delivers oil to each spooler. Each spooler is a fluid motor. The speed and torque of each spool is controlled by a hand operated valve on each spool. The traverse is accomplished by a double-end rod type of cylinder; the rod end facing the machine is attached to a frame which carries horizontal rods to which are attached filament guide hooks. The length of piston travel and therefore, the traverse movement of the rods and guides, is adjustable by means of stop nuts which engage the face of the blind end rod face to reverse the cylinder.

The hydraulic drive has eliminated the need for clutches, springs and other mechanical parts. Its use makes the spooler extremely simple in design and operation. With speed and torque positively controlled, each spool is wound with more equal tension than usually realized with mechanical devices. The light tension used in spooling prevents properly oriented threads from collapsing the spool, causing shaft binding.

In a typical production operation the spooler is the third of a three machine setup. As shown in Figure 1, the extruder and the orientation machine are the first and the second elements. The monofilaments are extruded downward through die orifices spaced equidistant in a circle. Standard extruding die heads have from 12 to 20 orifices of .023 in diameter or smaller. With this size orifice monofilaments of .009 in diameter are spooled after orientation and shrinking.

Immediately after the hot filaments leave the die they drop into a cold water bath (not shown in Figure 1), pass over a crossbar under water and out to guides which direct the filaments to the first set of Godet rolls which make up the second element, the orientation machine.

The orientation machine is made up of pairs of Godet rolls controlled so that speed changes of any pairs may be made simultaneously or separately. The number of sets of rolls varies from two to four or more depending on the type of filaments being processed. The orienting technique will be described by the operation of a three set or three-stage machine. The top row of rolls is horizontal and at right angles to the travel of the filaments. The lower row of rolls is set at an angle so that the filaments do not cross one another and so that they travel across the face of the rolls evenly. The filaments make four passes around the first set of rolls, then go to the second set of rolls.

The second set of rolls are driven about six times the speed of the first set of rolls. This stretches or orients the filaments to their greatest strength. The process is called orientation because the molecules of the plastic material arrange themselves, when stretched, in a parallel or link-chain design. All the orienting is done as the filaments leave the first rolls. The threads also make four passes around the second set of rolls, then enter a hot bath (85 C or 185 F), the travel through the hot bath being similar to the travel through the cold bath. The threads are then directed to the third set of rolls.

The third set of rolls are driven about 12 percent slower than the second set. This removes the tension to prevent after-shrinkage. From the third set of rolls (second or fourth in a two or four-stage operation), the filaments go collectively to a waste roll where each thread is separated and started individually on spools until each filament is spooled. The waste roll also acts as an emergency reel for threads which break in the orienting machine.

While the 20-spindle hydraulic spooler was designed to handle polythene and polyethylene filaments it has created a great deal of interest among manufacturers of tire cord and other cotton threads.

The spooler operates at oil pressures of 10 to 100 psi, with torques available for winding filament on empty spools that range from .26 to 2.38 in-lb at pressures from 10 to 80 psi.

Interest indicates that the textile industry has found the advantages of the multiple hydraulic spooler very attractive. In addition to the elimination of friction clutches and the advantage of easy, positive individual adjustment of speeds and torques, the use of one pump, motor and traverse cylinder for multiple spool operation represents an important saving in equipment cost.

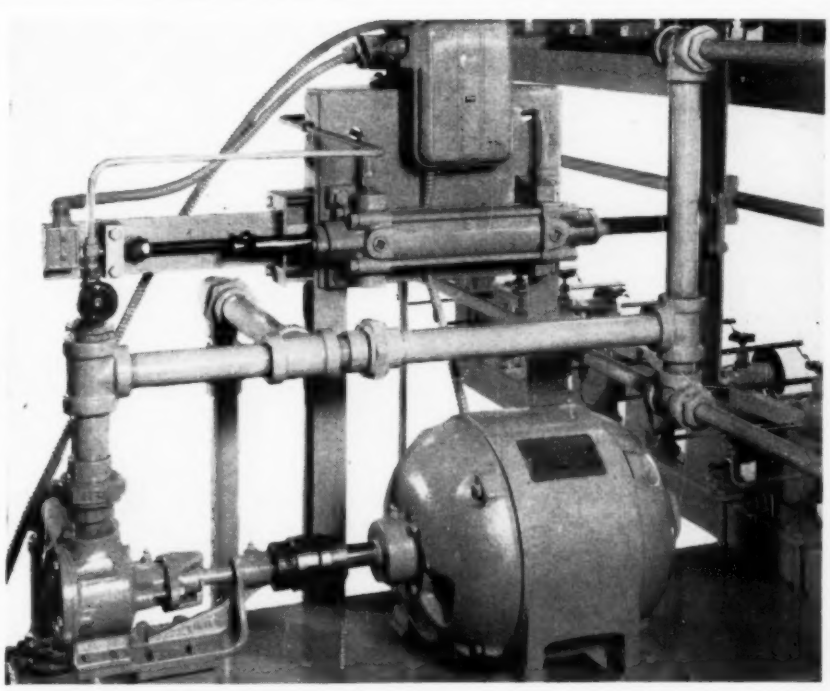


Fig. 2. The driving and traversing equipment is very simple. The pump, direct-driven through flexible coupling, the distribution system to the individual spools and the double-acting cylinder for traverse are shown.

WHAT ABOUT DIRTY OIL?

The price of dirty oil is always too high—with equipment for cleaning oil a forge plant cut their oil bill, reduced machine downtime and eliminated oil maintenance problems.

By F. R. WILLIAMS
Superintendent
Champion Forge Company
Cleveland, Ohio

IN A PLANT such as ours we keep a large volume of oil in use in the operation of our Hydro-tels and hydraulic trimming presses. Up to about five years ago we had a serious problem on oil replacement. On our Hydro-tels, for example, it was necessary to change the oil frequently due to the formation of heavy sludge deposits. While our practice was to add makeup oil, our war production program prevented our taking proper care of the machines. We found it impossible to take the machines out of production and clean them for each oil change as recommended by the manufacturer.

In our press department we had much the same problem. In our large hammer shop trimming presses are located adjacent to hammers. As the scale and die oil on the die surfaces was removed by steam the presses quickly collected a deposit of a gummy sludge. We did not shut the presses down—they shut us down. When the presses were down for an oil change, the cylinder lines and reservoir were cleaned. Cleaning a press took about three or four days—days out of vital production—which made the job costly. Such periods averaged every five or six months. Our records show that over 3000 gallons of oil had to be replaced each month based on normal steady operation of the presses.

Obviously, something had to be done about our oil. Changing from one grade of oil to another was not the answer because it did not touch the source of contamination. We knew that the nature of our operations was the major cause of the rapid contamination and breakdown of the oil we used. We knew that the oil would get dirty fast. The problem then, was one of finding equipment which would not only remove fine abrasive mate-

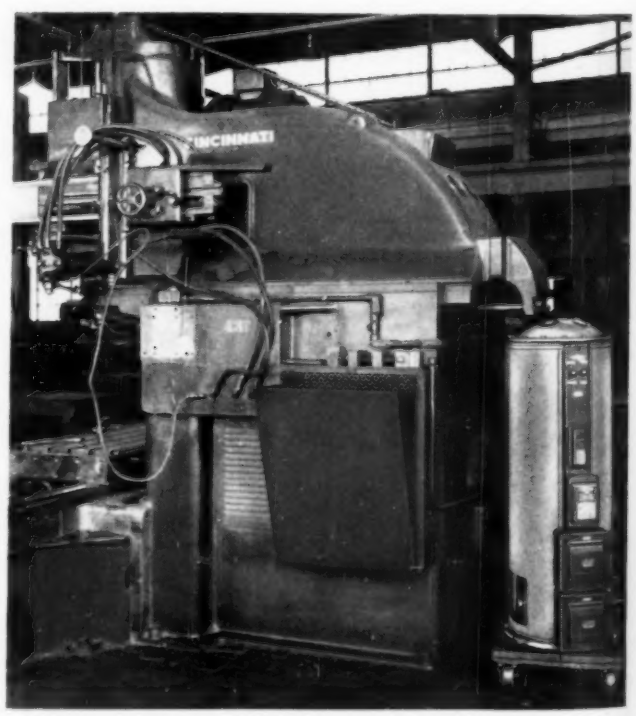


Fig. 1. A continuous type portable oil purifier unit operating with a Hydro-tel to provide clean oil.

rials, but, more important in our case, equipment that would take out the sludges and other oxidation products which were the main source of our problems.

Fortunately, shortly after our first experience with a frozen pump on one of our Hydro-tels, we had brought to our attention equipment for filtering or cleaning hydraulic oil. Five years ago we were at the peak of our war production and it was more urgent than ever that we find a solution for keeping our oil clean and our machines in production. We had so many drums of dirty oil stored in our plant that they became a space problem.

The oil cleaning units brought to our attention used fuller's earth as a filtering media for hydraulic oil. The local representative of a manufacturer of some of our major equipment and our oil supplier agreed upon the efficiency of fuller's earth in cleaning oil. It was decided to give this type of oil cleaning equipment a trial.

Since our Hydro-tel oil problem was particularly acute, due to the pressure of forging die work, we selected a continuous type portable unit with a built-in pump and motor and put it to work on one of our Hydro-tels.

We began with the unit on which the pump had frozen. Our test consisted of moving the purifier unit close to the Hydro-tel and connecting lines to the machine oil reservoir. This was done without interferring in any way with the operation of the machine. After 24 hours, the unit was disconnected and moved to the next machine. In this way the oil in each of our nine Hydro-tels was cleaned. Tests made of reservoir oil after the 24 hour cleaning period proved that the oil was indistinguishable from a fresh charge.

The purifier unit, still in operation, is dolly-mounted for ease of movement from machine to machine. Equipped with an inlet and outlet hose, it can be connected to quick-couplings on the reservoir, plugged into an electric outlet and put in operation in two or three minutes by the least skilled laborer. Aside from moving the purifier and changing a refill every three or four months, its operation is entirely automatic and fool-proof.

The purifier continuously pulls one and a half gallons of oil per minute from the bottom of the reservoir, passes it through a deep bank of fuller's earth and discharges it back through the reservoir fill-hole or other high point.

This type of purification, since it is carried on while the machine is in operation, has a decided advantage over the batch method. When a reservoir is drained, 5 to 15 percent of the old oil is left in the lines and sump. This old oil, due to the scavenging action of the new oil, increases the deterioration rate and accelerates sludge formation in the new oil. Circulation through the purifier while the machine is in operation allows the clean oil to carry away deposits and maintain the entire system in clean condition.

This method of keeping our oil free from contamination was an important factor in helping us meet heavy forging die production schedules. This is, of course, just as true today as it was five years ago.

Could we do the same for our presses? The oil handling problem was different. Due to the large oil capacities of our trimming presses it was more practical to remove the oil, clean or purify it and then return it to the press. To do this, a purifier unit was installed into a pyramidal platform in our shop close to our parts stock room.

A drum of dirty oil was placed on the top of the platform and connected to the inlet of the purifier by piping. A travelling crane was used to place the full drum on the platform. The purifier outlet pipe was connected to an empty drum stood on its base near by. The oil was then run through the unit; the dirty oil entering the unit and the clean oil leaving the unit. This installation, which we set up as a temporary expedient, has done so well that it is still in regular use. Our experience has been that cleaned refills of oil have lasted from 4 to 5 months with average press operation.

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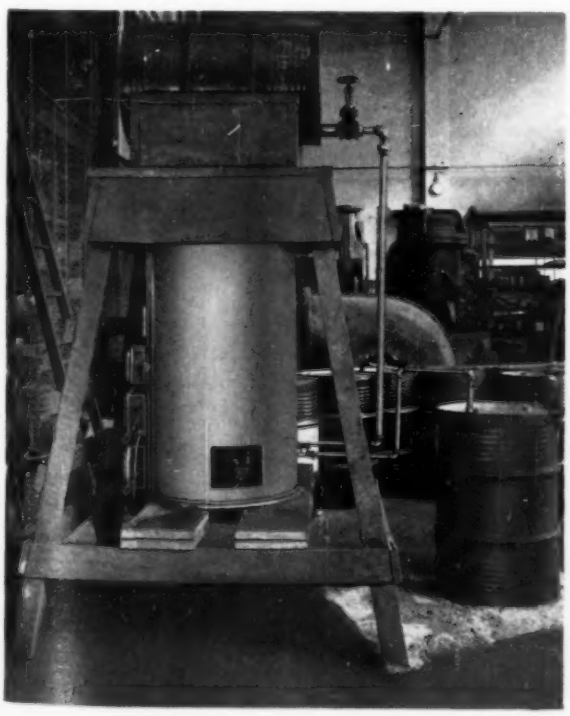


Fig. 3. The setup at Champion Forge Co. for batch cleaning of oil for their hydraulic trimming presses.

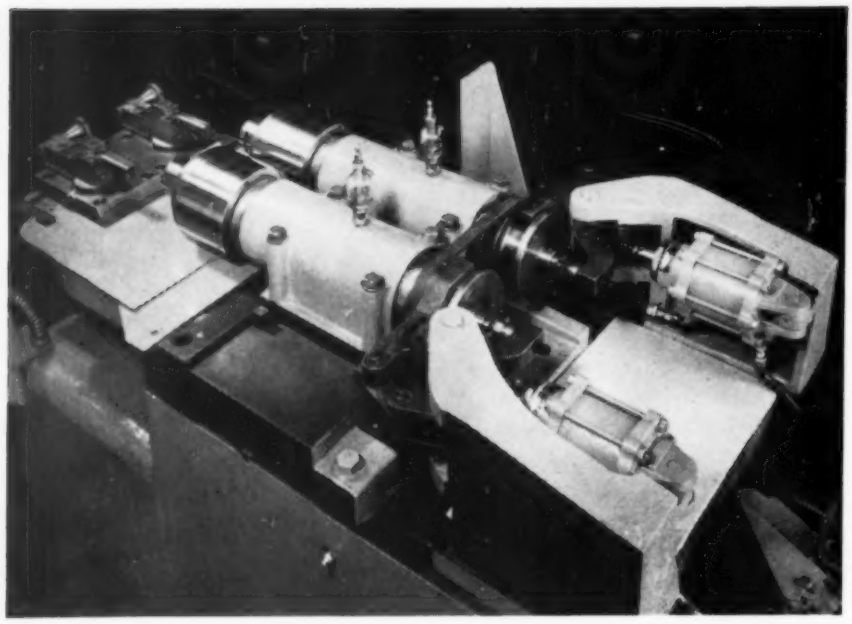


Fig. 1. Rear view of machine showing air cylinders used for chucking operations.

AIR CONTROLLED SLIDES FOR PRECISION CONTOUR WORK

CONTOUR boring and turning of second operation work with accuracy, speed and ease is possible on a design announced by The New Britain Machine Company, New Britain, Connecticut. The use of cam and air actuated tools positively assures repeated operation from piece to piece.

The whole design of this machine (Model 36) is centered around the tables or slides which are cam actuated and pneumatically opposed by air cylinders. Cam operation assures positive action of the table at all times regardless of temperatures or other conditions.

The two air cylinders used for unchucking (see Figure 1) have a 3 in diameter and a 1 in stroke, while the cylinder operating the table has a 3 in diameter and a 5 in stroke. The contour slide cylinder is the smallest with a 2 in diameter and a 2 in stroke.

The cylinder operating the table is located under the table and the contour slide cylinder is on the back of the machine operating through a bell-crank lever.

The cylinders connected to the table and to the contour slide oppose the action of the cams and maintain the pressure of the follower on the cam contours. This prevents any sloppiness which might cause inaccuracies in the finished work. At a proper point in the work cycle, when the operation has been completed, the table cylinder withdraws the tool from the work on rapid traverse.

This design is adaptable to a great many different jobs because either work or tool may be held in the spindle and a variety of setups applied to the table. On large pieces requiring boring or turning, the work may be placed in a stationary fixture on the table, the tool rotated; on smaller pieces the tool may be held stationary and the work rotated. The table and contour slide are operated axially and radially through disc type cams.

In addition to regular straight boring and turning, facing and chamfering jobs, the machine will accurately follow contours ground on its cams and will produce lands, recesses, flanges, steps, counterbores and radii—all with a single point tool, or a multiple arrangement of single point tools.

Rapid traverse on all idle motions and the finishing of two pieces simultaneously make this design doubly productive; cam actuated tables being opposed by pneumatic cylinders give an extreme overall accuracy that is unaffected by external or internal temperature changes. These factors all add up to increased production—lower cost per piece manufactured.

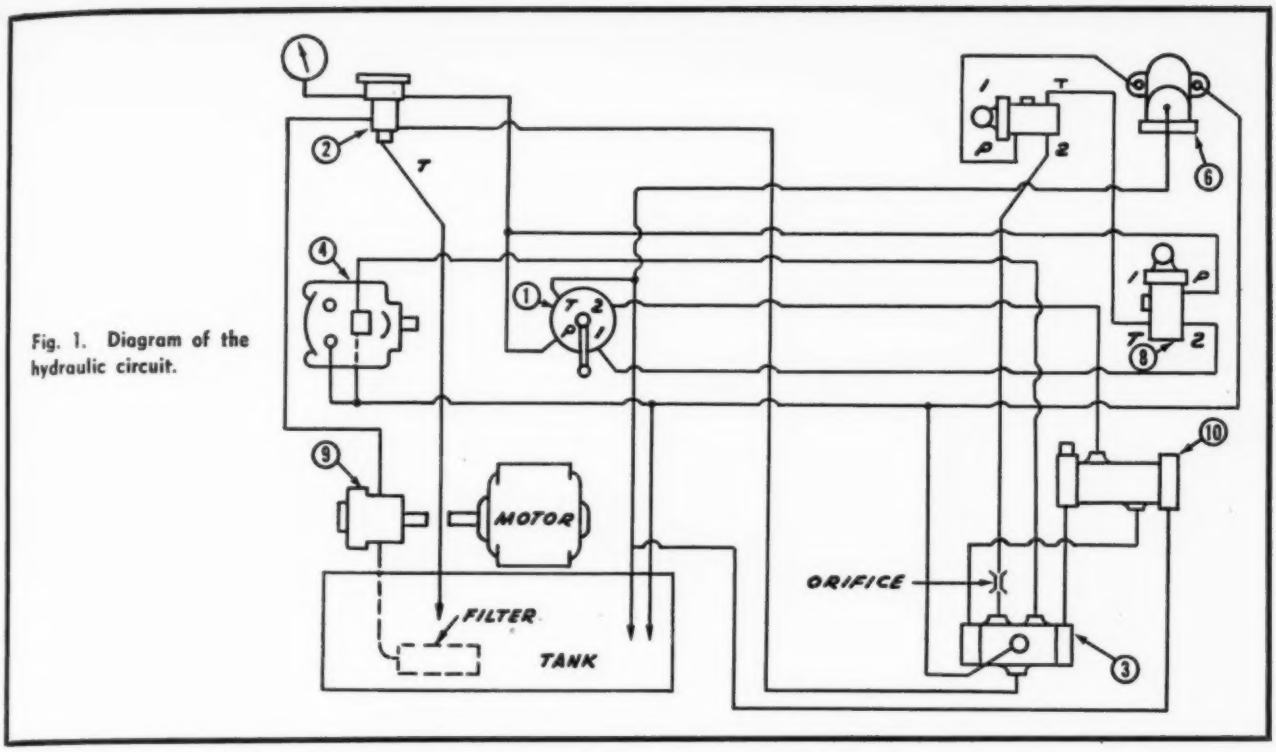


Fig. 1. Diagram of the hydraulic circuit.

DESIGN FOR SINGLE SOURCE CONTROL

The hydraulic circuit in this machine was the result of the development of original plans to achieve full automatic control with the simplest and most fool-proof equipment. While a war time development, the circuit has worked so well that the machine is still in regular production

THE HYDRAULIC system described below was worked out for a special purpose lathe during the war. Designed and built originally for turning gun barrels, the machine operated around the clock during the war years. Its operation has been so satisfactory that the lathe has been successfully applied to regular peace time production. It is still in operation 18 hours per day in the shop of a leading gun manufacturer.

We did not start the design of the machine with hydraulic actuation or control in mind. The actual system is the result of a very interesting development. In our original plans we incorporated a motorized spindle; we tried various means of electric control and air control to interlock all the various functions. Working under considerable pressure to arrive at the simplest and most fool-proof operation, we decided on a prime mover in the form of a motor and pump so that all sequences could be performed and interlocked from one source.

By E. W. CLEM
Chief Engineer
Rice Barton Corporation
Worcester, Massachusetts

Basically, the hydraulic circuit is a constant pressure system which, by means of a four-way valve, delivers fluid under pressure to a fluid motor which drives the work spindle and feed shaft for the tool carriage for the work part of the cycle; then, by a mechanically operated reversal of the valve spindle, the fluid is diverted to a second fluid motor which returns the carriage to its starting position.

In its completed design the machine was, and is, fully automatic with the exception of the hand operation of inserting the work piece and pushing a lever to start operations.

The elements of the circuit

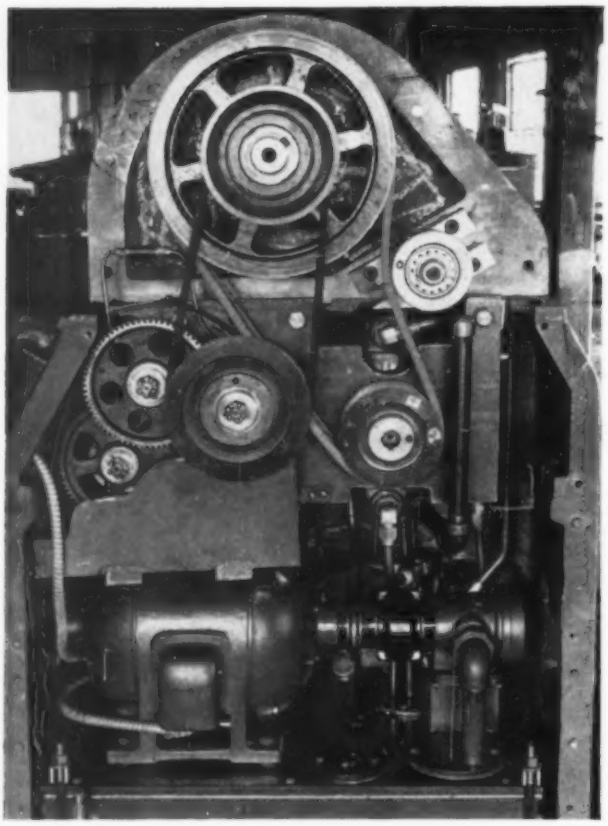


Fig. 2. The motor, pump and tank in the base of the lathe head.

will be discussed in turn in the order of the oil pressure flow. These can be followed by reference to the diagram of the system, Figure 1.

A constant delivery vane type pump (9) is directly driven by an electric motor. The pump delivers 3.3 gpm at 0 pressure and 2.5 gpm at 1000 psi, the normal operating pressure of the system.

The outlet pump line is connected to a metering valve (2), which is actually a combined control and overload relief valve. This valve is provided for the purpose of controlling the maximum operating pressure and to maintain oil flow to the fluid motor (4) at a constant volume, regardless of the operating pressure. The control valve has a metering capacity of 2.5 gpm at any pressure.

The four-way valve (3) is located between the metering valve (2) and the fluid motor (4). The four-way valve is connected to the return fluid motor (6), two four-way valves in the reversing circuit, the time delay valve (10) and to drain.

Oil pressure on the work part of the cycle is then directed to the fluid motor (4). This is a piston type variable displacement motor which drives the work spindle and feed shaft for the tool carriage.

On the return part of the cycle the fluid flow, as described below, is diverted from fluid motor (4) to return fluid motor (6). This action returns the tool carriage, completing the cycle.

Four-way valve (8), actuated by a point cam (not shown) vents the relief valve in the control valve (2) and returns oil flow through pilot valve (1) to drain.

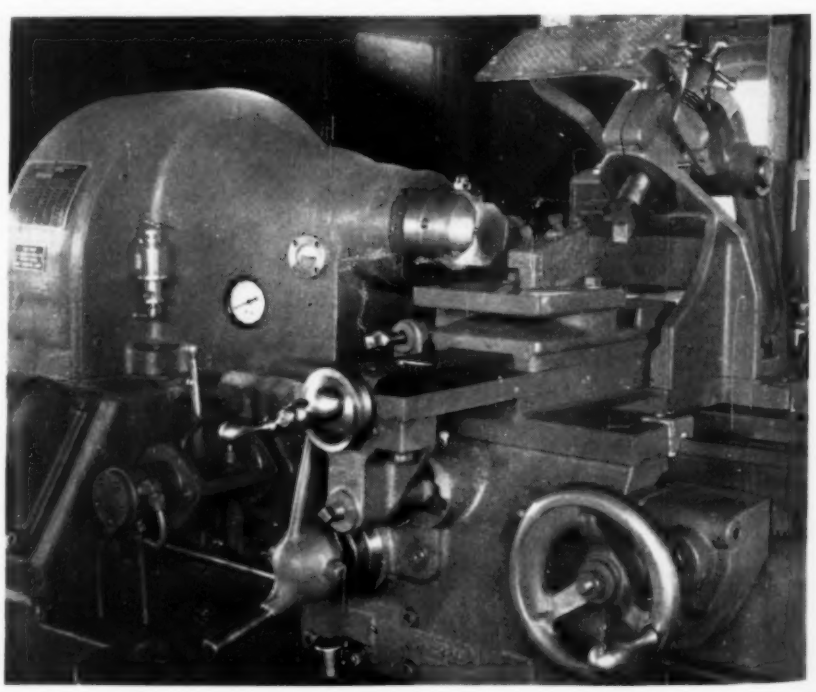
Fluid motor (6) is a fixed displacement gear type motor and its function is to return the carriage to the starting position after a mechanically operated friction clutch disengages the carriage from the feed shaft.

A time delay valve (10) is provided to furnish a dwell time for the disengagement of the friction clutch in the apron and to relieve chip pressure on the tool before the reversal operation starts.

The oil flow in terms of the work part of the cycle by reference to the diagram is: 9-2-3-4-tank. The flow to return the carriage is: 9-2-3-6-tank. The purpose of the second four-way valve (8) is to vent the relief valve in the control valve (2) through the pilot valve (1) to the drain.

(Continued on next page)

Fig. 3. The head stock end of the lathe showing the pilot valve and the manually operated lever which starts the operation of the cycle.



LETTERS to the Editor

We have seen the first two issues of APPLIED HYDRAULICS, and looking through your magazine, and the advertisements shown, we believe that there is a definite need for this magazine to tell the people in industry what can be accomplished with hydraulics.
We are a manufacturer of high production precision machinery, the Planetary milling machine, and many times we are called upon to equip our machine with hydraulic units. We are writing you to find out if there is a clearing house for hydraulic data and information. Do all of the hydraulic people belong to an Association, or is there some place that we can write and get general information on what the various hydraulic manufacturers build and make?
Any information you can give us will be greatly appreciated.

Charles K. Lenning, Jr.
Vice President
The Hall Planetary Company
Philadelphia, Pa.

We have received the February issue of APPLIED HYDRAULICS.
This magazine, in my opinion, will bridge a gap usually left open in most of the technical magazines.
I feel that there is a definite need for a magazine devoted to this specific field.

Wm. E. Bakewell
Chief Engineer
Viking Pump Co.
Cedar Falls, Iowa

Having seen two issues of APPLIED HYDRAULICS to date it has just occurred to me how really timely this publication is. Many have spoken of the tremendous increase in the use of hydraulics during the war period, and this is certainly true. What is more important is the still increasing usage of hydraulics since the end of the war, and that which is projected for the future.
To one who saw the infinite potentialities of this field of mechanics, this is most gratifying. Equally gratifying is the fact that this industry now has a first-rate trade journal.
I sincerely hope you keep up the general tenor displayed in the first two issues.

W. C. Trautman
Hydraulic Engineering Director
Pacific Division, Bendix Aviation Corporation
North Hollywood, Calif.

I have just had the pleasure of reading the first issue of your APPLIED HYDRAULICS. I want you to know how very pleased I was with the entire magazine. The articles are all very interesting and I am sure that it will meet a long felt need in the hydraulics field.

P. N. Oberholtzer
Hydraulics Engineer
American Engineering Company
Philadelphia, Pa.

(Continued on page 22)

The machine operation is controlled by the manual rotation of the pilot valve (1). See Figure 3. Turning the lever in a counterclockwise direction blocks the relief valve vent of the metering or control valve (2), directing oil pressure to the left hand side of the four-way valve (3). This directs pump delivery to the spindle fluid motor (4).

Due to the fact that the control valve (2) has a maximum metering capacity equal to the pump delivery at full load, the volume of oil delivered to the spindle fluid motor (4) is always constant. The variation in speed of fluid motor (4) between no load and full load will be approximately 4 percent, with a maximum of 6 percent.

At the end of the work cycle a trip dog (not shown) rotates the pilot valve (1) clockwise; this directs pressure to the right hand side of the four-way valve (3), cutting off oil flow from fluid motor (4) and opening the port to return fluid motor (6). This, as we have seen, returns the tool carriage to its starting position. At this point, the point cam depresses four-way valve (8) to vent relief valve in control valve (2), ports "P" to "2" and through pilot valve (1), port "2" to port "T" to drain. During the work cycle the relief valve vent port is blocked at port "1" of valve (8) after the point cam has released this valve.

Control valve (2) also may be used to reduce the speed of fluid motor (4) under 663 rpm, in which case, the horsepower output would be reduced in direct proportion to the speed. Speed variation of fluid motor (4) between 663 rpm at maximum torque and 2406 rpm at minimum torque is regulated by the handwheel control furnished with this motor.

The control for both fluid motors (4 and 6) is such that either can be rotated by hand in both directions at such times when pump pressure is relieved.

The mechanical interlocks, the dog trips and cams for operating the two four-way valves, have functioned very satisfactorily. They have been left off the circuit diagram only to keep the system easy to follow.

We have found that by using a fluid power system we were able to expose all piping and connections on the rear of the machine. The problem of saturation of electrical connections by moisture and cutting oils was eliminated; as well as the risk of contamination of the electrical control by chips, dust and other foreign shop matter.

The machine was designed for hard usage and has been, and is being, maintained by the average "run of the mill" mechanic. The valves and piping are so arranged that any branch of the circuit may be examined by breaking a tube union connection or by opening a pipe plug. This can be done in a matter of a few minutes, the trouble corrected and the machine restored to production.

A recent routine inquiry brought the information that the lathe was at the point of requiring replacements of motors and pumps. This, we were told, was considered merely as a life factor element. There is no thought of discarding the machine which still is turning out work to the close tolerances required by modern gun making. In a very real sense this lathe with its hydraulic system is "carrying on".

DIRTY OIL

(Continued from page 15)

With our previous experience we were a bit doubtful of our oil man's statement that oil never wears out, but we have lost our skepticism with our experience with equipment that keeps oil in substantially its originally delivered condition. Not only have we made a very considerable saving on our oil cost—it is necessary to add makeup oil only—but the production time saved and the maintenance costs eliminated have paid for the purifier units many times over.

HYDRAULIC CIRCUITS SPEED O
MULTIPLE OPERATIONA

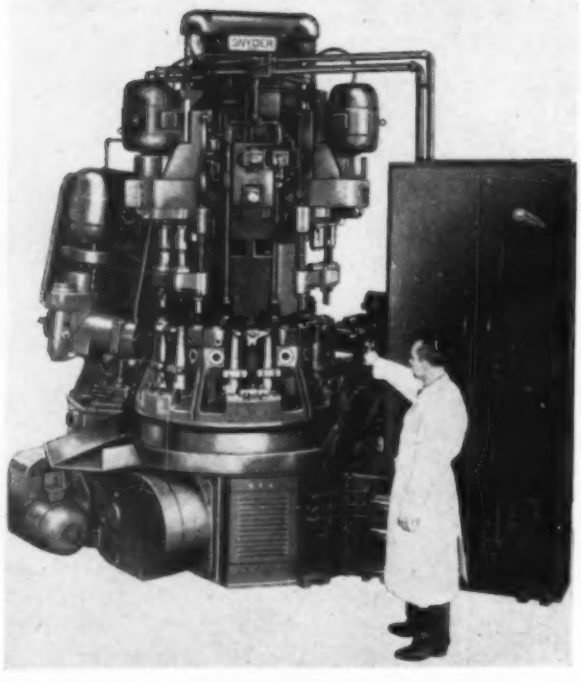


Fig. 1. Front of the center column machine. The operator is actuating the motor switch for operating the pumps and spindles.

Hydraulic circuits in a multiple operation production machine give simplicity in design and operation, flexibility, ease of maintenance and the long, trouble-free operation so essential in the high production industries.

THE COMBINATION of multiple machining operations in a single automatic machine has been an important factor in raising and maintaining the high production rates so essential in the automotive industry. In the design and building of such special machines, hydraulic circuits have played and are playing an important role. The machine described is a center column machine designed to bore the small end, spotface flange holes, drill, tap and mill the mounting pad on a transmission extension. The machine was designed and built for the Ford Motor Company.

The center column of the machine carries two boring heads and one spotfacing head. A rotary table is indexed around the center column. Six fixtures, each carrying two parts, are mounted on the rotary table. Both the center column and the rotary table are mounted on a welded steel base, to which three side units for the milling, drilling and tapping, are also attached. The Geneva indexing mechanism is mounted to the side of the base in a readily accessible position.

The part material is cast iron of Brinell 163-228. At a rate of

Operation by Stations

Station No. 1. Loading and unloading station. The operator unloads finished parts and loads new parts.

Station No. 2. The two spindle head rough bores and faces the bearing oil seal hole. Boring tools are guided by a rotating ball bearing bushing.

Station No. 3. A two spindle, side mounted milling head, fitted with carbide tipped end mills faces the mounting pad boss. This boss is inclined at a 6 degree angle from the vertical and all units machining this surface are on the same angle.

Station No. 4. A four spindle head spot faces two holes in the transmission mounting flange. The bushing plate for guiding the spotfacing tools is brought in from the rear hydraulically and is retracted for indexing the table.

Station No. 5. Two holes are drilled in the mounting pad bosses of both parts. The tools are guided in a travelling bushing plate.

Station No. 6. A two spindle head performs a semi-finish bore and a four spindle individual leadscrew tapping unit performs the tapping operation. The boring head is mounted on the center column and the tapping unit is attached to side of the base.

D ODUCTION IN A ONACHINE

By ROBERT L. BREHM
Snyder Tool & Engineering
Company
Detroit, Michigan

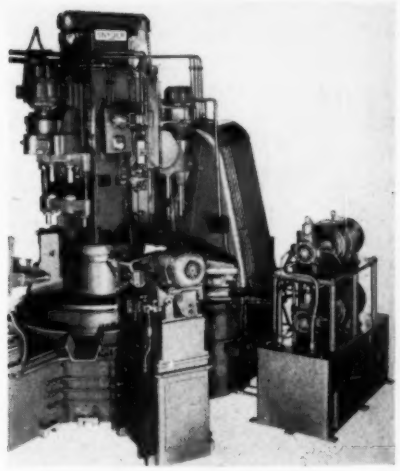


Fig. 2. The rear of the machine showing the mounting of the pumps and motors and the streamlined transmission lines.

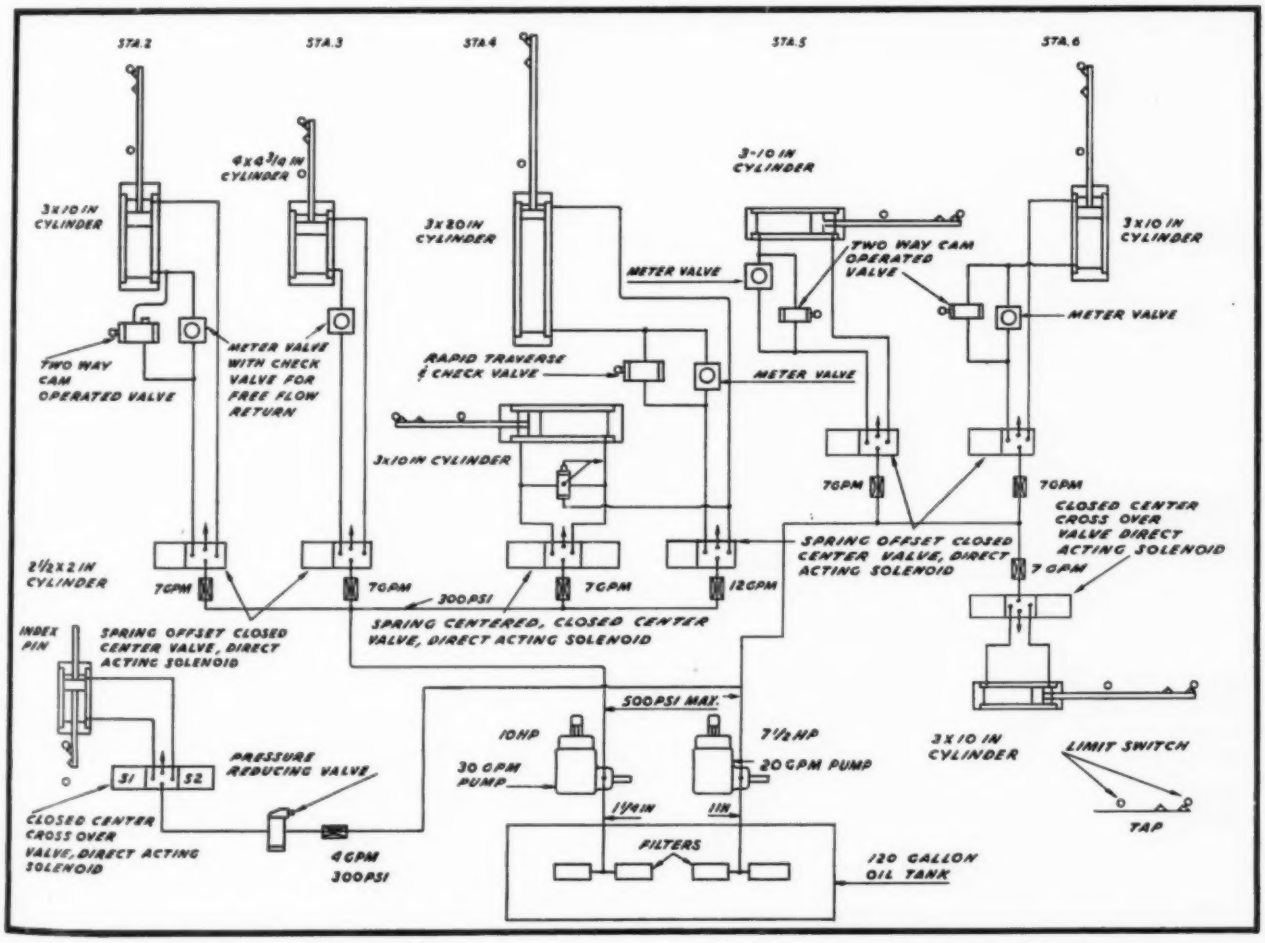
two parts every 38 seconds, 187 parts per hour are finished at 100 percent efficiency and 150 parts at 80 percent efficiency.

The machine is operated by one man who manually unloads two machined transmission extensions and loads new parts in station No. 1, while all other stations are working.

All the units are hydraulically operated and electrically interlocked for safety.

Two radial vane type automatic variable volume constant pressure pumps, rated for continuous operating pressures to 1000 psi, are used. The diagrammatic sketch of the circuits (Figure 3) shows that the 20 gpm pump supplies the locating

Fig. 3. Diagram of the hydraulic circuits.



pin of the entire table (the fixture itself being manually operated), stations 5 and 6; the 30 gpm pump supplies stations 2, 3 and 4. The pumps are mounted, one over the other, on the reservoir (Figure 2). The pump and tank installation, being entirely clear of the machine itself, permits ready access for maintenance. All tubing is fitted snugly against the center column, base and shields and, wherever possible, tied together. This helps reduce damage to the transmission lines caused by vibration and presents a clean, neat appearance.

The Work Cycle

To start the work cycle with work in the stations, the operator starts the motors which operate the pumps and spindles. He then unloads the two finished transmission extensions and loads two new pieces in station No. 1. He then indexes the table by means of a cycle button which starts the index motor, so that No. 1 station becomes No. 2 station. The hydraulic locking pin comes out at start of index cycle and is inserted at end of index cycle before the heads cycle. During loading and unloading the index pin is engaged because the work stations are operating at that time.

In station No. 4 the small 3 x 10 unit advances through its stroke, powering the spotfacing operations; then larger unit 3 x 20 advances as valve HV-15870 (made by Snyder) opens both cylinder ports to drain, allowing the 3 x 10 unit to be positioned by the 3x 20 unit.

The horizontal unit of station No. 6 is used only to bring the tap into place for the cycle. The horizontal unit station of No. 5 is used to advance and feed drills.

After a shut down, emergency return or manual operation, the first cycle of the machine will occur without an index unless the cycle setup button is used.

A separate centrifugal type pump driven by a ¼ hp 1800 rpm motor is used to deliver coolant to the taps. The rest of the operations run dry. A normally closed valve is actuated by a cam as the tap head comes forward, allowing the coolant to flow onto the taps during their work cycle. When the taps are pulled away from the work, the cams allow the valve to close and stop the flow of coolant. The coolant circuit to the taps is independent, of course, to the hydraulic system. The only tie-in is that the shutoff valve is actuated by the cam on the slide that moves the taps into place.

The lubrication system is by hand lubrication and drip feeders.

Work Cycle

I	Motors running except taps.
II	Unload and load parts which other stations are machining.
III	When all stations are returned, cycle machine again.
IV	Locating pin is hydraulically withdrawn.
V	Table is indexed by index motor.
VI	Locating pin is inserted hydraulically.
VII	All heads cycle forward except one which waits for bushing plate at station four and it follows in sequence.
VIII	As soon as index is completed, the operator starts unloading finished parts and loading parts to be machined, while heads are going through their cycles.

Hydraulic power is used because it permits simplicity of machine design and is extremely flexible as to feed rates, timing, etc. Electrical interlock is used to prevent clash of movements such as an index when heads are forward, or heads coming in when index is out of place or moving.

The advantages of hydraulic actuation in the center column machine are typical for automatic, high production equipment. The advantages are: a minimum of equipment required to perform machine functions; the simplicity of the easy-to-follow circuits; the flexibility in feed rate and length of stroke; and the long, trouble-free operation that is so essential in the high production industries.

LETTERS TO THE EDITOR

(Continued from page 19)

The first issue of your newly published magazine APPLIED HYDRAULICS looks very good in regard to contents. A magazine of this sort is really needed because it will make it possible to collect and concentrate the experience and knowledge in the field of applied hydraulics in one medium.

J. Decker
Engineering Supervisor
The Cincinnati Milling Machine Co.
Cincinnati, Ohio

I have had occasion to read through your first copy of the new publication APPLIED HYDRAULICS and wish to congratulate you upon material well chosen and interestingly presented. I wish you much success.
I am much interested in hydraulic techniques and like to keep abreast of new methods. I have occasion to incorporate hydraulic systems and mechanisms in much of my mechanical designs.

L. J. Reggiardo
Engineering Services
Maywood, Calif.

While in Cleveland, at the ASTE Show, I picked up the first copy of your magazine APPLIED HYDRAULICS.
Please accept my congratulations on your latest venture as it has definitely filled a gap in the dissemination of hydraulic information to industry. If others intend doing the same as I, your periodical will be regarded as a textbook and filed intact for future reference. I am sure this magazine is everything you had intended it to be.

A. L. Landesberg
Superintendent of Equipment
I-T-E Circuit Breaker Company
Philadelphia, Pa.

May we compliment you on your very fine publication. Its contents are loaded with interesting hydraulic and pneumatic applications and educational to the hydraulic trade.

Paul Bates
General Manager
Hydraulic Straightening & Manufacturing Co.
Los Angeles, Calif.

We were fortunate in being able to peruse volume 1, No. 1 of your new publication APPLIED HYDRAULICS. If you continue with the quality of publication as you started, your success should be assured.
While our particular industry is not a great user of hydraulically activated movement or control, nevertheless, we feel that it would be much to our advantage if we could continue to receive this publication.

R. K. Morse
Product Design Engineer
The Brunswick-Balke-Collender Co.
Muskegon, Mich.

This column is open to comments on general trade and technical problems. Readers' questions and answers will appear regularly—EDITOR.

SAVE THIS VALUABLE REFERENCE MATERIAL; BUILD UP A PERMANENT FILE

HYDRAULIC CIRCUITS, II

THE USE OF THE COMBINED DISPLACEMENT OF HIGH AND LOW PRESSURE PUMPS TO ACTUATE BOTH STROKES OF A PISTON

By GEORGE N. DORR
Dorr-Patterson Engineering Company
Detroit, Mich.

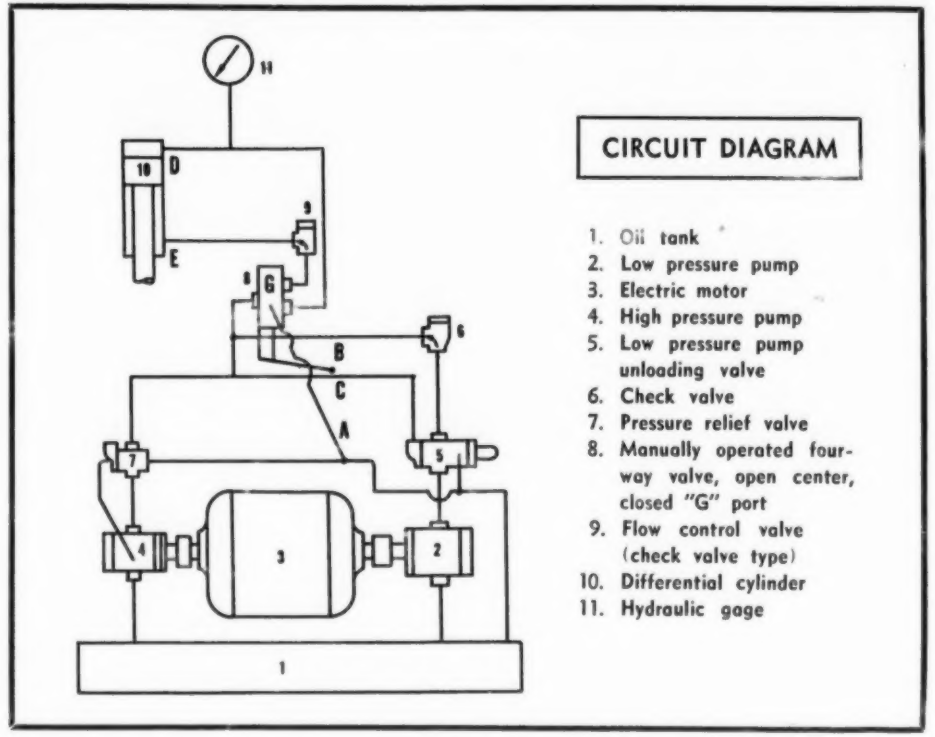
CIRCUIT OPERATION

THE HYDRAULIC SYSTEM shown in the adjacent column employs two pumps, one high pressure, one low pressure to operate a differential cylinder by means of a manually operated four-way valve. The combined displacement of both pumps actuates the cylinder piston on both strokes.

Movement of the operating lever to position "A" permits fluid displaced by both pumps to enter cylinder at port "D", forcing the piston down. Fluid expelled from port "E" flows through control valve (9). When pressure reaches a predetermined value, the displacement of low pressure pump (2) is by-passed to the tank through pump unloading valve (5). Fluid from high pressure pump (4) continues to actuate the cylinder piston.

Movement of the operating lever to position "B" diverts the fluid to the cylinder through port "E". Fluid expelled through port "D" returns to tank through four-way valve (8). Check valve (6) protects low pressure pump (2).

When the operating lever is at position "C", the combined pump displacement is by-passed through four-way valve (8); piston remains stationary if port "G" of the valve (8) is blocked.



CIRCUIT DIAGRAM

1. Oil tank
2. Low pressure pump
3. Electric motor
4. High pressure pump
5. Low pressure pump unloading valve
6. Check valve
7. Pressure relief valve
8. Manually operated four-way valve, open center, closed "G" port
9. Flow control valve (check valve type)
10. Differential cylinder
11. Hydraulic gage

TROUBLE SHOOTING CHART

When the system does not develop full pressure, it may be due to:

1. Not enough oil in system or wrong grade of oil—too light
2. Air in system or entrapped in oil
3. Loose inlet to high pressure pump
4. Defective high pressure pump
5. Defective relief valve or not properly set
6. Leaks by ports of operating valve
7. Too small motor—defective motor or coupling or motor hooked up for wrong voltage
8. Cracked or scored cylinder
9. Leak in pipe line
10. Defective seals on piston head or rod end
11. Loose gland, not drawn up square
12. Defective gage
13. Check valve (6) not seated
14. Blocked inlet to high pressure pump

When the system does not develop any pressure, the cause may be:

1. Defective motor or coupling
2. Defective pumps; not turning over, or turning in wrong direction
3. Not enough oil in system
4. Defective gage
5. Operating valve defective or in discharge position
6. Broken pressure line
7. Motor turning in wrong direction; burned out fuse
8. No resistance to forward movement of ram
9. Air vent in tank blocked
10. Inlet to pump blocked
11. Defective relief valve

When full speed does not develop, it may be due to:

1. Lack or wrong grade of oil; oil too thick
2. Air in system
3. One or more pumps defective or turning in wrong direction
4. Low pressure pump unloading
5. Check valve (6) not seating
6. Relief valve defective
7. Operating valve defective; too small or not at full opening
8. Loose gland or drawn up too tightly
9. Defective seals on piston head or rod
10. Flow valve (9) not set correctly—sticking
11. Motor defective, wrong speed, or hooked up for wrong voltage
12. Mechanical bind in piston or cross head
13. Inlets to pumps blocked or too small
14. Blocked air vent in oil tank
15. Too much friction in pipe line

When down-stroke is irregular, up-stroke regular, check for:

1. Air in system
2. Not enough oil in system
3. Discharge through port "E" excessive; hole in valve (9) too large
4. Loose gland
5. Mechanical bind in piston or crosshead
6. Pump displacement not large enough
7. Defective packings
8. Low pressure by-pass valve defective
9. Broken piston ring or loose packing plate
10. Air vent in tank blocked
11. Load off center of press
12. Valve (6) defective

When up-stroke is irregular, down-stroke regular, check for:

1. Loose gland
2. Piston head seals defective or loose
3. Discharge through cylinder port "D" irregular, obstruction in line, line or operating valve too small
4. By-pass valve (5) defective
5. Mechanical obstruction in piston or cross head
6. Air in system
7. Sticking valve (9)
8. Defective packings

8. Defective packings

When both strokes are irregular, it may be caused by:

1. Entrapped air in system
2. Excessive air in oil in tank, wrong grade of oil
3. Loose inlet connections to pumps
4. Loose gland, not pulled up square
5. Misalignment of piston or cross head
6. Defcctive pumps
7. Defective unloading valve
8. Defective relief valve
9. Defective packing
10. Defective operating valve
11. Leaks in line
12. Broken piston rings
13. Defective cylinder bore or piston
14. Air vent in tank blocked
15. Check valve (6) defective
16. This action is to be expected with a single plunger pump

When pressure builds to maximum slowly, look for:

1. Air in system; air vent in oil tank blocked
2. Ram drops too fast; too large hole in (9)
3. High pressure pump too small or defective
4. Oil contains too much entrapped air; wrong kind of oil
5. Not enough oil in system
6. Defective operating valve
7. Defective packings

When full stroke is not developed, the cause may be:

1. Not enough oil in system
2. Mechanical block of moving parts
3. Bent columns
4. Not enough pressure developed to overcome load
5. Air in system

If operation is noisy, look for:

1. Lack of oil in system
2. Entrapped air
3. Misalignment of pump and motor
4. Pipe lines not properly anchored
5. Sudden release of pressure; valve too large
6. Vibration of pump or tank
7. Defective pump
8. Defective relief valve

Motor heating up may be due to:

1. Too small to carry the load
2. Low pressure pump operating at pressure too high
3. Low pressure valve defective or not set at correct unloading pressure
4. Motor defective or hooked up for wrong voltage
5. Misalignment of motor and pumps
6. Lack of circulating air to cool motor

Heating of oil may be caused by:

1. Valves or pipe lines too small
2. Wrong grade of oil or dirty oil
3. Not enough oil in system; oil tank too small
4. Pump turning over too fast
5. Wire drawing in valves or seal on head of piston
6. Processing hot materials
7. Defective pump
8. Excessive amount of liquid being by-passed over relief valve
9. Cooling system in oil tank defective
10. Air vent in tank too small

Air in the system may be due to:

1. Defective packings
2. Leaks in joints
3. Loose inlet to pump
4. Too little oil in tank or wrong grade of oil
5. Inlet to pump too high
6. Defective pump
7. Loose gland
8. Cracked cylinder
9. Entrapped air in oil

A TELESCOPIC CYLINDER

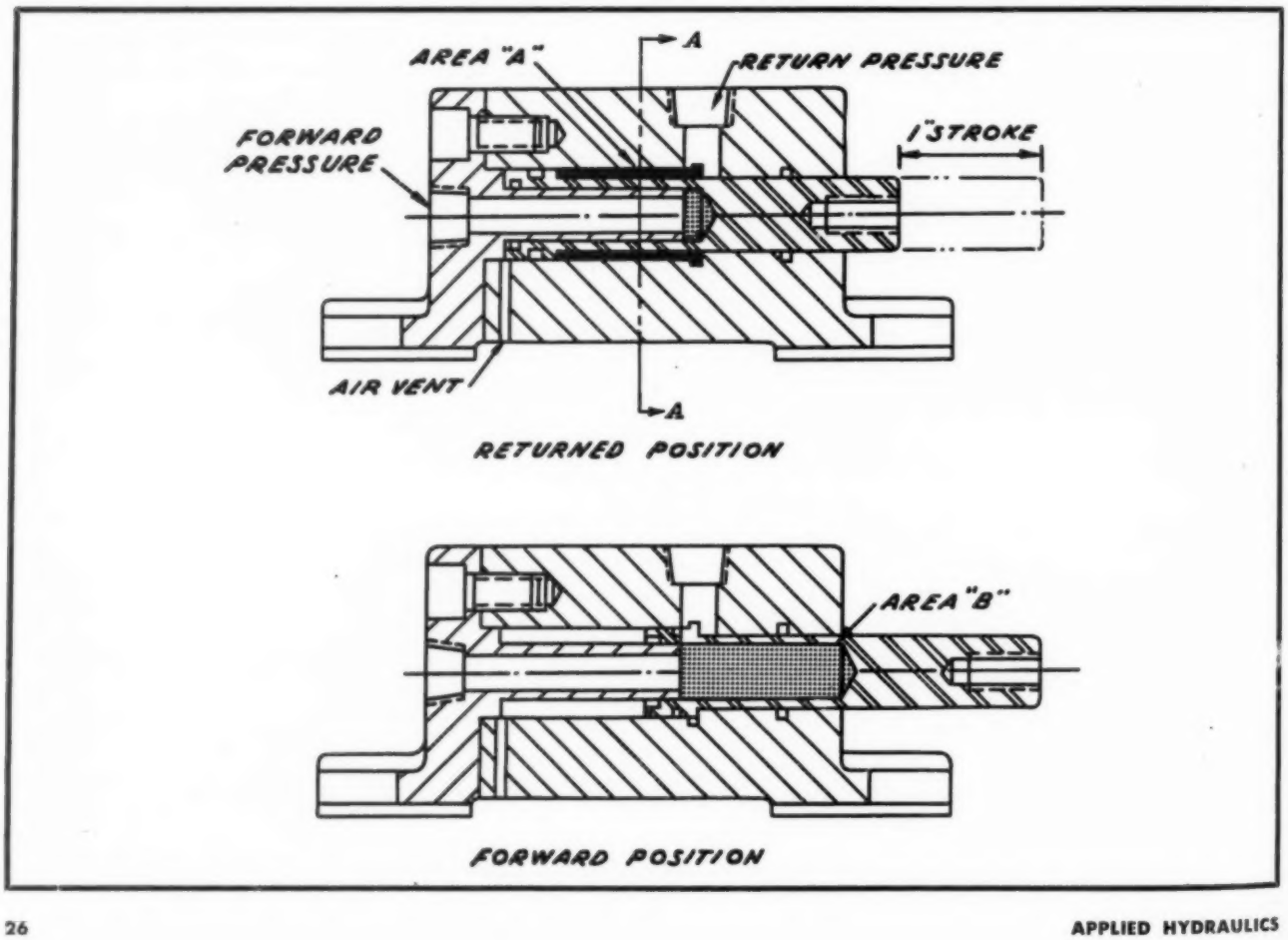
By JOHN MACEWKA
Wolverine Hydraulics Co.
Royal Oak, Mich.

A SPECIAL double-acting hydraulic cylinder developed to operate a surface grinding machine table, contains a single rod for operating at equal speeds in either direction without any change in fluid pressure. The design of the single rod permits it to do work done by two rods in a conventional double-acting cylinder. This application also eliminated the use of two conventional double-acting hydraulic cylinders, when they are placed along side each other, but opposed, to operate machine tables (i.e. OD and ID grinders, and milling machines) with the same speed in either direction without any change in fluid pressure.

A piston of the same operating area as the difference between the areas of the working rod and its piston diameter is inserted in the piston and rod as shown in Figure 1. Since there is the same displacement in either chamber, the piston operates at the same speed in both directions.

This may be understood by reference to the drawings which are not to the same scale. Area "A", in the returned position, is shown in annular cross section. This area is .1105 sq in. Area "B", in the forward position, is also .1105 sq in.

The working rod diameter, shown extended in the forward position, is one-half in, an area of .1964 sq in. The piston diameter of the rod is five-eighths in, an area of .3068 sq in. The difrence between the area of the rod and its piston give an operating area of .1105 sq in. This

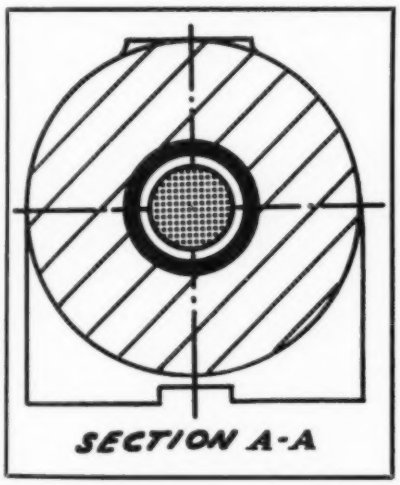


is equal to the area of the three-eighths in diameter piston which is inserted. In operation the same volume of fluid is displaced from the forward position to the return position and reverse. Without any changes in pressures the rod operates at the same speed in either direction.

If a differential speed is desired a faster feed and a greater force on the return of the rod may be obtained by increasing the annular area "A" or by decreasing the area "B". This is being performed by cylinders which have been installed on a vehicle for declutching a four front wheel drive. The cylinders are operated at 1500 psi. The forward force on the rod is 200 psi and the return force is 300 psi.

Rod Design Origin

The cylinder was, in fact, developed for this application where a double rod could not be used and the return force had to be greater than the forward force.



In addition to the original application for which this cylinder was designed, it may be used on a drill press for tapping operations. The rod of this cylinder may be coupled to a drill press spindle and the oil pressure regulated to operate the rod to correspond with the pitch of the thread. This serves as a metering device instead of a lead screw.

Useful Literature

The publications listed are available without charge. Mark the initial key number on the card bound in this issue and mail.

25. Horizontal Pumps... Horizontal two and four plunger pumps, primarily for service with hydraulic presses, are shown in Bulletin 270-A being distributed by The Watson-Stillman Co. All of the pumps shown can be made in styles to suit many different operating conditions—to serve one or more presses requiring constant or high and low pressures with or without accumulators. All pumps are furnished with direct motor drive of suitable power. Two-plunger, medium duty type will produce pressures to 8600 psi; four-plunger, heavy duty type to 12,000 psi. Photographs and specification charts are included.

26. Coolers... Type "BCF" oil coolers are described in Bulletin No. 4922 distributed by Ross Heater & Mfg. Company, Inc. This type, featuring transverse baffling, has been designed and developed to meet the need for a small, light weight, compact heat exchanger for oil. Two types are available—multi-pass flow and single-pass flow. Photographs and drawings included in this bulletin show the design characteristics of this cooler type, with the last page devoted to sizes, weights and dimensions of available models.

27. Micronic Filters... A four-page bulletin, on the industrial micronic filters produced by Greer Hydraulics, Inc., is available. The filter elements used in these units are the same as those incorporated in aircraft filters where purity of oil is of utmost importance. The element has a convolute shape and is capable of filtering particles of 5 microns size. The unit illustrated is a 30 gpm, 250 psi filter, but other sizes can be supplied on request. Design drawings, photographs and a performance characteristics chart reveal construction and efficiency of these micronic filters.

28. Fluid Drive... Industrial applications of Gyrol fluid drive units produced by American Blower Corporation are reviewed in Bulletin 7019. Photographs and drawings show typical applications. Design drawings, performance charts and selection tables review two types of hydraulic couplings offered. Complete oil circulating systems, with oil cooler and pump, for use in conjunction with the fluid drive unit are also reviewed in detail.

29. Instruments and Controls... Bulletin 17 reviews the general line of instruments and controls for the process industries produced by the Bailey Meter Company. Non-indicating, indicating and recording models are included. Sections on air operated control and measuring components and schematic drawings of typical control systems are included.

30. Hose Coupling Handbook... Hose Accessories Company has issued a handbook and service manual for assistance in: how to select proper couplings; how to attach the couplings and how to avoid hose abuse. A preliminary section, devoted to hose coupling terminology, contains illustrations of types defined. Charts are used for the selection section and drawings and photographs are used to illustrate the assembling techniques. The facts and short cuts in this handbook and service manual should aid the user of hose equipment in securing greater efficiency and lower operating costs.

31. Air Compressors ... The reciprocating piston-type, single acting, air cooled air compressors produced by The United States Air Compressor Co. are described in Catalogue No. 47. Single stage and two stage, 1, 2 and 4 cylinder types are shown —single stage for less than 150 psi; two stage for more than 150 psi. The single stage units range in size from ½ to 1½ hp; the two stage units from 1 to 5 hp. A section in the beginning of this catalog is devoted to general information and engineering data, while in the remaining sections the different types of compressors are described by photographs and design drawings. Air accessories and replacement pumps are also included.

32. Vane Pumps ... Fixed displacement, single vane pumps manufactured by Vickers Incorporated are reviewed in Bulletin 40-25a. Three series are available—small, intermediate, large —for capacities ranging from 1 to 60 gpm at 1200 rpm. Operating pressures up to 1000 psi. Design and construction drawings show details of these pumps; performance curves reveal their operating efficiency. The pumps are available in foot, flange and no mounting types. The last page shows other types of pumps and power units also available.

33. Solenoid Valves ...Skinner Electric Valve Division, The Skinner Chuck Company has prepared Bulletin 470 describing their stainless steel V5-solenoid valves. They are available in 2-way normally open or closed and 3-way 2-position models, with ⅛ or ¼ in inlet and outlet. They can be used for service to 250 psi. A wide range of ac and dc voltages are provided for. The last two pages of this bulletin are devoted to auxiliary equipment offered and to graphs of valve capacities.

34. Tex-Book ... Allis-Chalmers offers a complete manual of engineering information on their Texrope drives. Drive tables arranged in ratio or driven speed sequence, include driven speed, horsepower, service factor, center distance, sheave combination, catalog number and types of drives. For special drives complete engineering tables are included. Edge index and classified index make this manual fast, easy to use.

35. Industrial Hose ... Aeroquip Corporation has available, in loose-leaf form, a bulletin on their line of industrial hose, self-sealing couplings and hose fitting tool kits. Complete specification pages give illustrations, sizes and prices of the miscellaneous hose assemblies and fittings; several pages illustrate and describe assembly instructions. Bulletin No. 110 containing design drawings and photographs, price lists and sizes of self-sealing coupling is also included.

36. Hydraulic System Solvent ...An industrial technical memorandum, available from Socony-Vacuum Oil Co., Inc., Lubricating Department, describes the characteristics and uses for S/V Sovalent A. In many instances it is possible to remove deposits from system surfaces by adding a solvent and circulating it through the system. S/V Sovalent A is recommended for this purpose. This memorandum gives the principal physical characteristics and procedures for use. Charts showing final viscosities also included.

37. Cylinder Calculator ... Hanna Engineering Works has prepared a hydraulic cylinder calculator for computing hydraulic problems. It is quick and accurate and can solve a number of problems from effective area to pump efficiency. The calculator is a handy size and incorporates scales on both sides of its surface. A handy folder of directions explains what the cylinder calculator will do. Practically the entire range of identical cylinder applications is covered.

38. Rotary Air Motors ... Rotary air motors, to 1 hp. are reviewed in literature available from Gast Manufacturing Corporation. Two types are shown: a portable unit from 0 to 1/6 hp and a stationary-mount unit in two models from 1/20 to 1 hp. The units are small and light and can be used for a variety of unusual jobs. Explosion-proof work is tailor-made for these motors. Complete photographs and drawings show design details and unit applications as original and as auxiliary equipment. Performance tables are also included.

39. Radial Hydraulic Pumps... The design of Seco radial hydraulic pumps and their principle of operation are explained in a four-page pamphlet prepared by Simplex Engineering Co.; T. E. Raymond, president, is the author. The construction, seal characteristics, valving and the circuit are treated in detail. Also available, in conjunction with this pamphlet, is an 8-page bulletin, on Seco fluid power units that includes design drawings, exploded views and performance charts on these radial pumps. The units are capable of reaching 10,000 psi.

40. Air Control Valves ... Folder A, illustrating many of the designs and types of valves now in production, is available for distribution by Valvair Corporation. These valves, produced for control of compressed air, incorporate packers that seal without the use of metallic seats. They are made in five sizes from ¼ to 1 in in nine basic designs. Photographs show the different basic designs and drawings illustrate the features incorporated.

41. "Handy Data on Brass Fittings" ... is the name of a new folder No. 352 recently published by The Imperial Brass Mfg. Co. One of the features of this folder is a section showing distinguishing features of various types of tube fittings. Compression, flared, inverted flared, flex, hi-duty, threaded, sleeve and brass pipe fittings are included.

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1. Provide one compact, easy-to-install unit containing the major parts of the hydraulic system.
2. Provide a hydraulic system designed to fit your specific needs.

Hydreco PVT 10 combination pump, valve and tank unit — a complete hydraulic system in **one unit** except for cylinders. Effective tank capacity is 92 cu. in. — pump capacity is 1-1/4 gpm @ 3000 rpm.

Hydreco TV 30 tank and valve unit. Effective tank capacity is 300 cu. in. — maximum valve capacity is 14 gpm.

Hydreco PVT 31 combination pump, valve and tank unit. Effective tank capacity is 1000 cu. in. — pump capacity is 7 gpm @ 1200 rpm.

● You can save on fittings and piping because Hydreco combination units (either PVT, TV, or PV) simplify the hydraulic circuit.

The single, sealed unit affords added protection against shocks and vibration which often cause leaks in joints and connections where less unified systems are used. These units also reduce or eliminate difficulties arising from surge pressures and inertia in the oil lines. Assembly and mounting of the hydraulic system in the product is simplified to reduce the cost of installation.

There are over 120 different models in the complete Hydreco line of combination units.

Pump capacities (at 1200 rpm) range from 1/2 gpm to 25 gpm — tank capacities range from 1 gallon to 10 gallons. Valve capacities to match. This wide range of combination models is indicative of Hydreco's policy to build hydraulic devices to fit the user's need.

Hydreco welcomes the opportunity to work with you in the early stages of new equipment design — to aid in developing the most effective application of the hydraulic control equipment. Inquiries are invited without obligation.

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Applied HYDRAULICS DIGEST

Abstracts, summaries and listing of articles on hydraulic and associated applications in industry; reports on prepared papers, talks and discussions of special interest to the hydraulics field.

Selecting Hydraulic Pressure Valves

L. S. Linderoth Jr., *Machine Design,* v 20, April 1948, pp 105-112.

Selection of correct hydraulic pressure regulating valves requires careful matching of the characteristics of the valves and the conditions in the hydraulic system of the machine. Although principles of the valves are well known, many factors contributing to successful application are not. Linderoth's article attempts to alleviate this condition by providing information on performance and use, and operation and design of the common types of safety valves, sequence valves, pressure regulators, relief valves, and pressure reducers. It is impossible to design a perfect regulating valve since a pressure differential is required to operate it—valve will not shut off "drop tight" below the pressure at which it is set to open. However, since it is possible to approach perfection, various means to this end are illustrated and explained. Each of the valve types is reviewed with a design sketch and explained at length as to its functions and operation. Although there is confusion and uncertainty in identifying the differences between safety, relief, and pressure regulating valves, actually any valve that has a means for adjusting the pressure at which it will open can be called a pressure regulator. Likewise any valve that will open at a set pressure, may be called a safety or relief valve. In other words the use of a valve will determine its name.

What the User Should Know About Tubing

E. J. DeWitt, *Machinery,* v 54, April 1948, pp 174-178.

Part II of two installments. (Part I digested on page 26, May issue APPLIED HYDRAULICS). Two methods of cold-drawing tubing are described; the conventional method and the new "Rock Rite" (patented) method. The latter method produces cold-finished tube of excellent quality with greater percentage of reduction per operation than can be effected by cold-drawing. The finished tube has improved workability. The machine, made by the Tube Reducing Corporation, consists of four major components: (1) a feed mechanism which rotates the tube in a non-constant manner while advancing it; (2) a tapered mandrel whose large end is only slightly smaller than the inside diameter of the tube to be reduced; (3) a pair of semi-circular dies with a groove, one end of which approximates the outside diameter desired on the finished tube and the other end the desired diameter on the finished tube; and (4) a mechanical means of reciprocating the dies in unison. The machine literally kneads the tube over the tapered mandrel a little at a time, but always in a different spot, until the full length of the tube has been reduced.

Applications of grades of mechanical and pressure tubing are briefly described and characteristics are listed in tables. Mechanical tubing is often used for hydraulic pressure lines. Where frequency and character of shock in the system are severe, pressure tubes, specially designed, are preferred. Mechanical tubing is often used for hydraulic cylinders at working pressures to 1500 psi. Three groups of stainless steel tubing are given and methods of distinguishing them are presented. One large table lists 28 types of pipe with characteristics and ASTM specifications.

A "Historical Museum on Paper" of American Instruments in Science and Industry

A series of installments or "galleries"—Jan, Feb, Mar and Apr 1948 issues of *Instruments.*

A review of 20 years of instrumentation by chronological presentation of new products and their significance and importance. A very unusual treatment that contains a wealth of basic data that would be useful as well as interesting to application designers and control engineers. Practically every instrument or device is illustrated and the digest comments are especially written by experts.

Automatic Lubrication of Steel Plate and Sheet Machinery

Francis A. Westbrook, *Steel Processing,* v 34, May 1948, pp 261-263.

A description of five machines for the steel industry which are equipped with automatic lubricating systems. In the first machine—a heavy duty high speed plate bending roll made by Bertsch & Co., Cambridge City, Ind.—a manually operated lubricator pump is gear or

chain and cam action driven. Meter-units at bearings are equipped with felt filters. The second machine—a squaring shear by Columbia Machinery & Engineering Corp. of Hamilton, Ohio has a central lubricating system for 11 main bearings. Flexible hose is used to carry fluid to bearings on parts in constant motion. The third machine, a "roller leveler", made by Voss Machinery Co. of Pittsburgh, is widely used in aluminum and other mills to level sheet. A high pressure type of cyclic lubricator is used to service 40 main bearings. The fourth machine, an intermediate press brake by Verson Allsteel Press Co., Chicago, uses a ratchet-driven, cyclic type system for main bearings, eccentrics and backshaft bearings. The fifth machine, a multi-slide machine for automatic high speed production of formed stampings from coiled stock, and a product of U.S. Tool Co., Ampere, N.J., employs a high pressure cyclic lubricator with a three-point reservoir to oil 35 bearings and the slides.

Controlling Pneumatic Cylinders

James L. Dooley, *Machine Design,* v 20, April 1948, pp 119-125, 196.

A number of factors that influence pneumatic cylinder design and a brief discussion on the factors that determine the force from such a cylinder for external work at any instant during the piston stroke preface the main discussion. These factors include pressure differential, effective piston area, friction losses, effects of leakage, piston and rod acceleration forces, head clearance at the end of stroke and cylinder temperature. On many jobs the highly compressible nature of air requires more consideration for control than given hydraulic cylinders. However, the compressibility of air puts air cylinders at a comparative disadvantage to hydraulic cylinders only when smooth starts or when accurate but varying intermediate positions are required with an irregular or odd load-stroke curve. When definite intermediate positions are required they can be obtained by arranging air cylinders of different strokes back-to-back with flexible connections, by the use of automatic pneumatic stops, detents, or a linear equivalent of a Geneva movement.

Snubbing or cushioning at the end of the stroke can be utilized to prevent banging and to exercise rate control. Restrictors, usually installed in the air lines to the cylinders, are useful in not only throttling to maintain a desirable differential across the piston but also to maintain a high air density in the cylinder to effect good damping. Restrictors in the exhaust line are essential for good differential pressure and damping control; exhaust restrictors may be used to permit free air exit over the greater portion of the stroke, after which the main exhaust port is covered with the piston so that

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New! VARIABLE VOLUME OIL HYDRAULIC VANE TYPE PUMP

ANOTHER RACINE HYDRAULIC ACHIEVEMENT — the new Model J Variable Volume Oil Hydraulic Pump. Compact Vane Type design allows installation of this pump in a space as small as 6" x 6". It will deliver 1000 pounds pressure per square inch and will maintain a 90% volumetric efficiency.

Variable Volume feature allows horsepower requirement of system to be held to demands of the maximum load. Racine Hydraulic engineers welcome the opportunity to review your needs and make recommendations for complete hydraulic circuits. Write for Catalog P-10-C. Address RACINE TOOL AND MACHINE CO., 1774 STATE ST., RACINE, WISCONSIN.

OUTSTANDING FEATURES

ADJUSTABLE VOLUME — Pump can be set to deliver exactly the proper volume of oil for any given job.

ACCURATELY BUILT—All parts precision made. Accurately ground vanes of special steel are self-compensating for wear. Rotor shaft mounted in anti-friction bearings. Entire pump is self lubricated.

LOW COST—Quantity production and standardization of parts make possible low cost that compares favorably with constant volume non-adjustable pumps.

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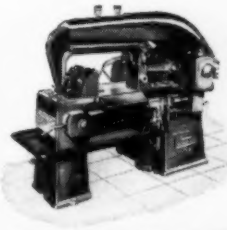
Variable Volume Pumps with either manual, mechanical, hydraulic or electrical volume control are available in capacities to 30 g.p.m. at pressures of 50 to 1000 lbs. p.s.i. Four-Way, Balanced-Piston Sleeve-Type hydraulic valves are also available in a wide range of styles and portings. Sizes ⅜" to 1½" I.P.S., lever, foot, pilot or solenoid operated.

RACINE *Hydraulic* METAL CUTTING MACHINES

If you have a metal cutting job whether it be soft aluminum or hard tool steel, tubing or bar, Racine has a saw in its complete line that will do the job. Sizes range from 6" x 6" to 20" x 20". Ask for catalog No. 12.



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the remaining portion of the stroke forces the exhaust air through a restriction for cushioning. Where definite speed control is required with all types of loads, e.g., a pneumatic cylinder automotive lift, it is usually advantageous to use fluid to control the piston speed. The air pressure may be applied to the hydraulic fluid in an accumulator and a hydraulic cylinder used, or the hydraulic control may be built into the cylinder. A separate hydraulic or mechanical snubber can be used or built into the air cylinder. Where pressure control rather than speed control is important, e.g., in a pneumatic rivet squeezer, two different size single acting air cylinders and a mechanical wedge apply a high but regulated load to the rivet. The smaller piston in the handle has a constant line pressure applied to it for the return stroke; the larger piston is supplied with air pressure by a three-way valve for operation and drain.

An air cylinder normally requires pressure to move in either direction, i.e., a four-way or two three-way valves linked together are required. A number of the air valves practical for such control are listed; groups of poppet valves, sliding valves and flexible tubes or diaphragms are briefly described and shown schematically.

Pneumatic Chip Conveying

H. M. Nichols, *Steel,* April 19, 1948, pp 81-82, 84.

Air conveyor systems have been standard practice in woodworking plants for quite a few years, but applications of this kind to metal chip handling is comparatively new. The widest field of useful application can be found on jobs where it is possible for the chips of small size to be drawn directly from the machine producing them. Long steel turnings must be crushed and screened before being conveyed pneumatically. Even under these conditions it has been found that pneumatic conveyors have such advantages as low initial cost and flexibility of installation. By conveying metal chips pneumatically man-hours can be saved and accidents reduced.

Air-Brake Clamping Jigs

Walter Rudolph, *Steel,* v 122, April 26, 1948, pp 109-110.

This article describes the use of air-brake cylinders as clamping devices in shop designed equipment. Manual clamping was replaced by air clamping and setup time was cut in half on operations being performed in the Loudonville, Ohio, plant of Flxible Co., manufacturer of transportation equipment.

Standard automotive air-brake cylinders are employed; plant line pressure of 90 psi actuates the cylinders. Dual-end clamping and off-center and deburring operations are some of the setups explained in detail.

Increased production—shorter setup time and fewer operations—are evidenced by the use of this unique method of clamping.

BOOK REVIEWS

Industrial Electronics Maintenance

R. C. Roetger. *First Edition. 190 pages, 5 x 8 inches. Published by Prentice-Hall, Inc., at $3.50.*

This little book, while intended as a text for trade school technical students, is a practical one for the plant maintenance man who wants to clarify and extend his knowledge of vacuum tube circuits and their practical applications. The book is divided into 16 sections each of which is well illustrated with diagrams and schematic arrangements. Of particular interest to the hydraulic maintenance man are sections on maintenance procedures, industrial electronic components, motor control (2 sections), automatic machinery control and servo systems. The last named is the simplest approach to servos that this reviewer has seen. Appendices give symbols, color codes, formulas and installation hints. A bibliography and index are included.

Theory of Servomechanisms

Edited by **Hubert M. James, Nathaniel B. Nichols** *and* **Ralph S. Phillips.** *Volume 16 of the Massachusetts Institute of Technology Radiation Laboratory Series. First Edition. 375 pages, 6 x 9 inches. Published by McGraw-Hill Book Company, Inc. at $5.00.*

This book presents a new design technique which makes use of statistical methods, an approach which was developed in the Radiation Laboratory during the war for automatic-tracking radar systems. The work is presented in two sections: The first analyzes the frequency response techniques (sinusoidal steady-state analysis as applied to electrical systems), the mathematical background is summarized and many applications are shown diagrammatically. The second section covers the statistical approach to proper servomechanism design. The technique depends on minimization of the rms error with which the mechanism produces a desired result in the presence of electrical noise and other disturbances.

An effort has been made to provide data that would be useful to every designer of servomechanisms. There is an excellent introductory chapter by I. A. Getting, a chapter on servo elements by C. W. Miller and one on general design principles by editor Nichols, W. P. Manger and E. H. Krohn. Phillips contributed chapters on statistical properties of time-variable data and rms-error criterion in servomechan-

(Continued on page 38)

Hydraulic Speed Indicator

J. A. Roberts, *Machine Design,* v 20, April 1948, pp 114-115.

A speed recorder and indicator for railway service, in which a hydraulic system is incorporated, is described in this article. A positive-displacement pump, producing an output that varies directly with the speed, is connected to the locomotive driver; the fluid output produced moves a piston that indicates and records the speed of the train. With this arrangement it is possible to indicate and record stable and accurate speed readings.

Hot Pressing Propeller Hubs

F. Welshner and A. A. Flout, *Steel,* v 122, March 15, 1948, pp 90-92, 121.

Drastic savings in forging, heat treating and machining time are made in the production of 575 lb three and four-way aircraft propeller hubs made of SAE 4340 steel. This is accomplished by using two special 6000 ton multiple acting, circular shaped hydraulic presses. Each press is composed of a vertical hydraulic cylinder and three or four horizontal cylinders which operate a combination of dies and plungers. The vertical ram exerts 2,000 tons pressure each and the horizontal rams exert 1000 tons. In the press structure no frames or columns are used; the cylinders themselves form the body of the press. The horizontal cylinders are keyed into a top ring and base and are movable allowing repositioning at different angular positions in relation to each other. The cylinders are intermittently operated at 5000 psi by a combination of two 3 1/8 x 18 horizontal duplex double-acting pumps of 350 hp each. The operating valves are controlled by a 500 lb. capacity servo system. Previous manufacturing methods for making propeller hubs from solid forgings, did not include the piercing of the barrel and shaft axis. With the new equipment the hubs are extruded to a depth of 5½ inches and the propeller shaft axis partially pierced. Sequence of operations are: The preheated rough forging is positioned in the lower dies and the verticle die and plunger pressed down on the forging blank. This forms the extension end of the hub and partially pierces the shaft axis; this securely holds the blank in the die. The horizontal water cooled rams now move in from the side and form the barrels of the hub. Knock-out pins in the lower platen prevent the forging from sticking in the die. The entire operation requires about 90 seconds. Advantages of this system over the previously used drop forging method are apparent in shorter work cycle, lower weight and improved physical properties—the additional working that the forging receives from hot pressing produces the better characteristics.

HERE'S *Compact Power!*

DENISON
Pumping Units
offer a size for every requirement

DENISON HydrOILic Pumping Units are compact, completely self-contained oil-hydraulic power units, universally applicable to both large and small equipment. They're suited to almost every type of industrial application, with a wide range of 13 models offered, in ratings to 2000 psi.

The standard units consist of electric motor, hydraulic pump, relief valve and oil level gauge; all mounted on the oil reservoir top. By removing four bolts, the entire assembly may be quickly inspected. Write us for complete specifications.

The DENISON Engineering Co.
1166 Dublin Road, Columbus 16, Ohio

DENISON EQUIPMENT for APPLIED HydrOILics

PUMPS • VALVES • FLUID MOTORS • HydrOILic PRESSES

New PRODUCTS

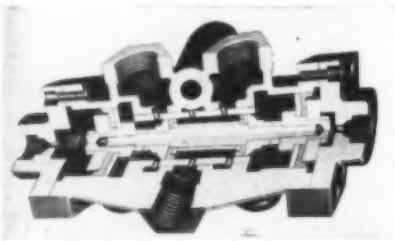
For additional information on any of these products, mark the end key numbers on the card bound in this issue and mail the card.

New Hydraulic Series

The Hydraulic Equipment Company announces a new line of pumps, valves and combination units. The new smaller combination units, consisting of pump, valve and tank, have a capacity range from ½ to 3 gpm. The new small 100 series pump is a low-cost production line item that can be used with the new combination units or as a separate unit. It is available with either a flange or base mounting. VB series control valves feature a built-in flow control and relief valve that gives improved operation on such equipment as bulldozers and front-end loaders requiring "up", "down", "float" and "hold" positions. In addition to the new units mentioned above, an unusual working model of a hydraulic system made entirely of colorless plastic will also be featured at the Chicago Road Show. This model will show in detail the workings of a hydraulic system. Use Business Reply Card, mark NP-1.

Redesigned Air Valve Line

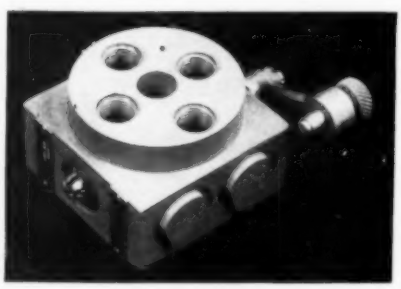
A completely redesigned and improved line of air control valves is now available according to an announcement by Logansport Machine Co., Inc.



Direct operated and remote operated control types are offered. Advanced sliding piston-type construction is featured in this design change. Balanced piston-type design gives effortless operation; fullpipe size ports and internal air passages permit unrestricted air flow and rapid response and wear and maintenance are minimized because of the elimination of valve seats and rod packing. All valves in the line are designed for operation at pressures to 150 psi. The complete line, with 79 standard models, is shown in detail in a new 48-page catalog offered to those interested. Use Business Reply Card, mark NP-2.

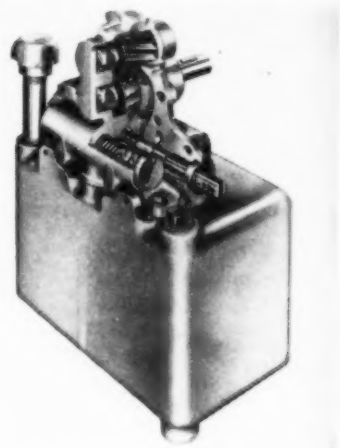
Four-Way Selector Valve

Electrol, Incorporated has developed a new 4-way selector valve for flow control of hydraulic systems. Light, compact and rugged, the valve consists of an aluminum alloy body, with line connections, and conventional spring - loaded, balanced - type poppet valves which direct the fluid to the desired outlet. Actuated by cams, the poppet valves are so arranged that rotation of the camshaft actuates the proper sequence and directs the fluid through the valve body. A position pin prevents overrunning of the camshaft. Efficient ducting and reduced pressure drops are assured by coaxial assembly and adequate passage size. Use Business Reply Card, mark NP-3.



Hydraulic Power Unit

A compact high efficiency hydraulic power unit, produced by Phillips-Drucker, consists of pump, valves and distribution manifold in one cast assembly. It may be installed as a unit or the tank and pump may be mounted separately. In this case tube connections can be made using holes provided for this purpose on top of tank. The maximum operating pressure is 1200 psi and the rate of output is approximately 15 gpm at 1100 rpm. For operation with double acting cylinders a special valve is provided. Special brackets for rear and side mounting are also offered. For tractor or automotive applications special couplings and gear shift type actuating levers can be obtained. Use Business Reply Card, mark NP-4.



Precision Switch

A new series of precision switches capable of handling high inrushes of current has been developed by Micro Switch, Division of First Industrial Corporation. This new type "A" switch provides three times the old standard inrush or load making capacity. It will handle 75 amps inrush and steady state current of 20 amps; 35 percent power factor at 460 volts ac or less on solenoid or motor loads. In this basic switch design, the actuator is an integral part of the basic switch case thus maintaining the same operating point during operation. Use Business Reply Card, mark NP-5.

Fast-Cycling Air Valve

A new electrically operated 4-way valve for directional control of air flow is announced by

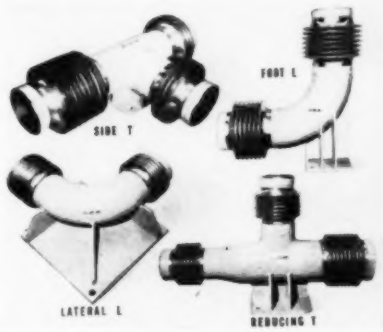
Hannifin Corporation. Designed primarily for fast-acting push button control of small air operated presses and similar units, this valve also has application as an automatic control, when used with limit switches or mechanical stops, on any air operated device. It is a "packless" reciprocating disc type, pilot operated and solenoid controlled. Two types are offered: Type I for double solenoid operation using two limit switches or push buttons; Type II for power-offset operation using a single switch. Either type will furnish 180 operating cycles per minute in handling air pressure from 25 to 150 psi. Three connection styles are available. Use Business Reply Card, NP-6.

Heavy Duty Cylinders

Ledeen heavy duty cylinders produced by Engineering Products Co. can be operated by air, oil or water. Cylinder diameters range from 2 to 8 in and stroke lengths from 6 to 36 in. The cylinders are made in one standard basic design but are available in four types of rod connections and six types of head mountings. Capacities range from 75 to 400 psi. Use Business Reply Card, mark NP-7.

Expansion Fittings

A new line of anchor base expansion joint pipe fittings is announced by Magnilastic, a division of Cook Electric Company. The number of bellows flanges can be varied to accommodate unequal expansion in any of the legs. This new line will be made for a full range of pressures from 30 in vacuum to 1000 psi. The pipe sizes offered will range from ½ in to 72 in.



Greater pipe sizes and higher pressures can be handled on special order. Use Business Reply Card, mark NP-8.

Mechanical Servomechanism

The Syntrol, an absolutely reliable automatic control capable of maintaining two or more power units in perfect synchronization, is announced by Taber Associates. Consisting of a pin-

In applied hydraulics

NO WEAK GAUGES NEED APPLY . . .

For the tough going encountered in hydraulic service only the best pressure gauge that money can buy is good enough. In the opinion of thousands of users this means Marsh. Because of its ability to maintain its accuracy under the most arduous operating conditions, Marsh Gauges have been adopted as standard equipment by 59 leading manufacturers of hydraulic machinery.

Built with lathe turned bourdon tube and precision, heavy-duty movement, the Marsh Hydraulic Gauge represents Marsh accuracy and stamina in its highest development. The standard dial is graduated in pounds per square inch, but special dials are available to indicate tons or pounds on rams, pistons, or converters; atmospheres; or double scales showing pounds per square inch and corresponding ram pressure. Gauges are available in a wide range of case styles, dial sizes, and pressure ranges up to 30,000 lbs.

Ask for new condensed booklet No. 60 covering commonly used Marsh Gauges.

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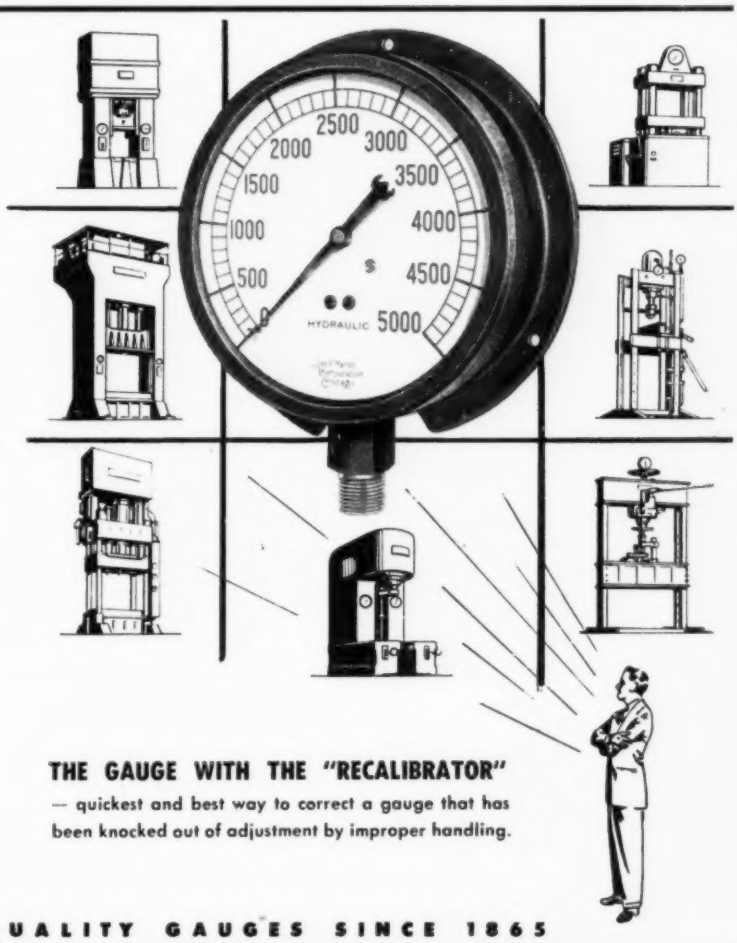


THE GAUGE WITH THE "RECALIBRATOR"
— quickest and best way to correct a gauge that has been knocked out of adjustment by improper handling.

MARSH

QUALITY GAUGES SINCE 1865

ion, for "lead" rotation and a screw for "follower" speed, this unit is capable of operation on engines, motors, machinery or any revolving mechanism. With additional controls, up to five following power sources can be handled. Use Business Reply Card, mark NP-9.

Solenoid Valve

The Airmatic Valve, Inc. introduces model DS-2 a new direct-operated solenoid valve

needing no pilot or other medium for operation. With an effective orifice area equal to that of the pipe line, this new valve can operate on direct or alternating current and can handle air, water and oil. The design eliminates packing requirements and incorporates a removable resilient rubber-type seat that provides a leakproof seal. It is available in 10 pipe sizes ranging from ¼ in to 3 in. Use Business Reply Card, mark NP-10.

Pipe Union

A new pipe union for high and low pressure work is now offered by DAS Division of The Defiance Automatic Screw Co. It is rated at 750 psi and is available in sizes up to and including 1 in. The union is made of special carbon steel with a brass seat especially designed to resist wear and corrosion. Use Business Reply Card, mark NP-11.

Multiple Arm Relay

Signal Engineering & Mfg. Co. offers sensitive multiple arm relays for control of industrial circuits and systems. These relays meet the demand for a multiple circuit switching relay that is able to function with small power consumption and occupy a minimum of space. The relay armature and the contact arms are mounted vertical to the base but the armature is so balanced with respect to the axis of rotation that the relay may be mounted in any position. Available contact arrangements range from single-pole, single-throw to four-pole, double-throw. Hermetically sealed or removable dust covers are offered for different service. Use Business Reply Card, mark NP-12.

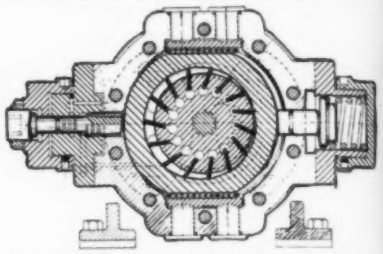
Electronic Interval Timer

Series 30 electronic interval timer, designed for machinery and process control, is available from Photoswitch Incorporated. With an interval range from 1/20 second to four minutes this timer is recommended for process control and machine timing where long life, repeat-cycle operation and precise accuracy are required. Four basic types of timing are provided: interval, delayed action, automatic repeat and programming, as

well as variations of these fundamental types. The unit has a repeat cycle accuracy within 2 percent and output through two single-pole, double-throw switches. Use Business Reply Card, mark NP-13.

Variable Delivery Pump

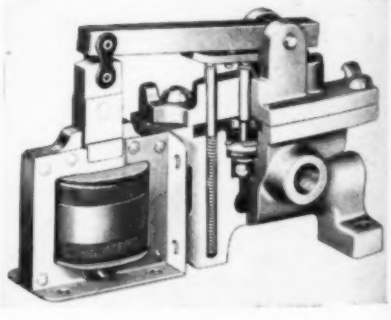
A new variable delivery vane type pump designed by Commonwealth Engineering Co. is now available for manufacture on a license basis. This unique design incorporates a slotted rotor with vane elements held in place by a shifting ring. The ring surrounds the rotor within the pump case. By shifting the ring, fluid space between the ring and rotor can be changed, thus varying the amount of fluid taken in at the suction port and delivered at the outlet port. Equipped with a control mech-



anism, the pump can be adjusted to deliver from 10 to 100 percent of maximum capacity in a sequence of one or two adjustable deliveries. This permits flexibility in application; a single pump unit without check or unloading valves can provide dual speed operation important to machinery drives. The unit has been designed in five capacities from 8 to 50 gpm at 1200 rpm and 1000 psi. Use Business Reply Card, mark NP-14.

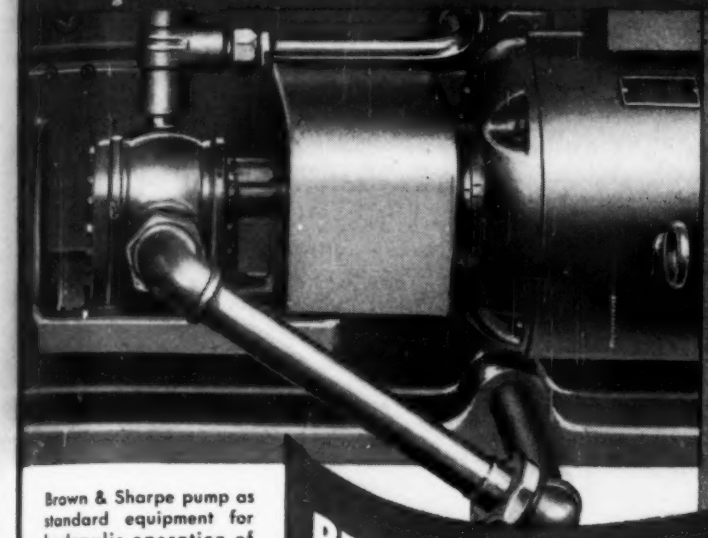
Four-Way Air Valve

A fast-acting 4-way solenoid air valve for industrial use is announced by Crescent Valve Company. It is lever actuated, spring biased and capable of delivering full volume of pressure line with minimum pressure loss while under continuous operation. The valve is made in ¼ in size only for 140 psi service but because of abnormal output may be substituted for conventional ⅜ in valves. Due to small size, light weight and freedom from servicing, this valve may be installed close to cylinder and in inaccessible places for maxi-

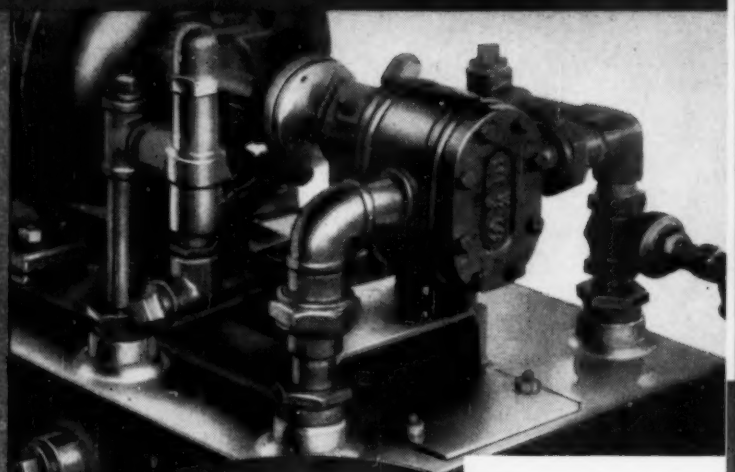


mum efficiency. The valve is also available for hand, foot or cam operation. Use Business Reply Card, mark NP-15.

RIGHT in their element . . .
ON HYDRAULIC SYSTEMS

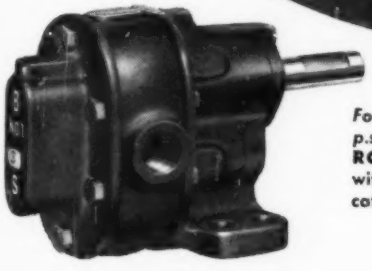


Brown & Sharpe pump as standard equipment for hydraulic operation of machine tool.

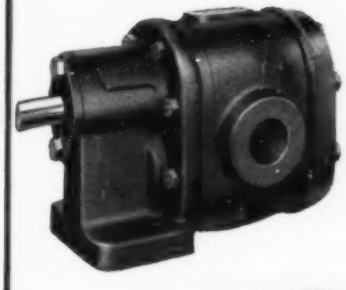


Compact installation of Brown & Sharpe pump for hydraulic operation of stoker unit.

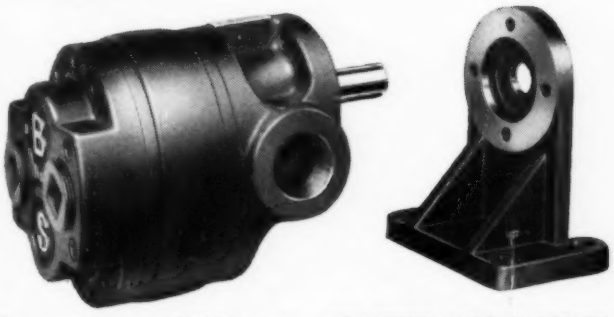
BROWN & SHARPE Rotary Geared PUMPS



For pressures up to 100 lbs. p.s.i. . . . **NOS. 1S, 2S and 3S ROTARY GEARED PUMPS** with helical gears. Self-lubricating.



For pressures up to 200 lbs. p.s.i. . . . **NOS. 53 and 55 ROTARY GEARED PUMPS** with roller bearings and helical gears.



For pressures up to 500 lbs. p.s.i. . . . **500 SERIES ROTARY GEARED PUMPS**—six sizes—with Herringbone Gears. Convenient flanged stand, needle bearings, ground joints, alloy steel shafts, reversible back drain for reversing rotation. All moving parts balanced hydraulically . . . the 4 larger sizes, are balanced mechanically also.

Because these rotary geared pumps are specifically designed for hydraulic service, their features show up to advantage in daily operation. They are simple, compact, dependable and quiet. Their gears are made with extreme accuracy . . . to standards that characterize Brown & Sharpe machines and equipment. All have a mechanical seal designed to prevent leakage and eliminate gland adjustments. Everything about these pumps . . . design, materials, and manufacturing . . . is the result of long experience in meeting pump requirements for machine tools and other machine equipment.

Thousands of these pumps in daily service are giving performance that proves they are RIGHT in their element on hydraulic systems. Get complete information and specifications. Write for Pump Bulletin. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment, held a three-day meeting at the Drake Hotel, Chicago May 3-5, under the chairmanship of B. R. Teree of The Weatherhead Co. Committee members who attended included: Ben N. Ashton, Electrol, Inc.; Fred O. Hosterman, Lockheed Aircraft Corp.; John W. Kelly, Adel Precision Products Corp.; J. Milton Kidd, Glenn L. Martin Co.; Harry Kupiec, Air Associates, Inc.; J. P. Kovacs, Purolator Products Corp.; and Frank Murphy, Douglas Aircraft Co. Inc. The Services were represented by L. M. Chattler, Bureau of Aeronautics, Navy Department; and E. M. Polk, AAF Air Materiel Command.

A total of approximately 50 hydraulic engineers representing the aviation, hydraulic and pneumatic equipment and airframe industries attended and participated in the discussions. Other industrial leaders who attended included L. S. Barksdale, Saval Co.; Ed Greer, Greer Hydraulics, Inc.; F. C. Mittell, North American Aviation; Nicholas Bashark, The Parker Appliance Co.; Mitchell M. Berry, Boeing Aircraft Co.; Dwight E. Leach, Chance-Vought Aircraft; L. J. Henderson, Aeroquip Corporation; Dave Grant, Hughes Aircraft; A. E. Matzke, Grumman Aircraft Engineering Corp.; and Duncan Gardiner, Vickers Inc.

The Foxboro Co. Ltd. has opened a new plant in Montreal, Canada that is said to be the largest building in Canada devoted to the manufacture and sale of industrial instruments. The Canadian company is affiliated with The Foxboro Co., Foxboro, Mass.

Several appointments have recently been made in the control divisions of General Electric Co.'s Apparatus Department, Schenectady, N. Y. K. R. Van Tassel has been named manager of the divisions; M. H. Blesh manager of manufacturing and C. B. Bradish manager of engineering.

Engineering Products Co. of Los Angeles has appointed Howard Ledeen as their new manager of sales. He will be in charge of the Ledeen heavy-duty cylinder sales.

The Bristol Company, Waterbury, Conn., is conducting a series of courses on the theory and application of industrial instruments. Each course, consisting of two weeks of intensive lectures and laboratory work, is open to plant instrument and operating men and others interested in application servicing and repair of instruments. Subjects covered include: instruments for pressure, temperature, relative humidity, flow, pH and electrical measurements; pyrometry; pneumatic, electric and electronic control systems and telemetering. The course will be under the direction of F. A. Faust, Education Department.

Henry F. Dever, president of Brown Instrument Company, Philadelphia, announces an expansion program that will add more than 60 percent to the company's present manufacturing space and a proportionate increase in employment. Increased sales and expanded research and engineering activities are the main reasons for this expansion. The program includes construction of a four-story addition to the main plant.

BOOK REVIEWS

(Continued from page 32)

ism design. In this latter chapter a method is developed by which an engineer may choose the best design for a servomechanism of a given type. In a final chapter C. H. Dowker and Phillips suggest a program for the practical use of these data by computing optimal servo parameters for two simple servomechanism of standard type at a variety of inputs. In the second part of this chapter the rms-error criterion is applied to manual tracking, a type which has important military applications.

Vickers Inc. has expanded its application engineering facilities by two appointments to its staff: Fred V. Gieryn as manager of the Rochester office located in the Genesee Valley Trust Building; James W. Kelley as manager in Tulsa, with offices in the Thompson Bldg.

A special summer refresher course in sales engineering, to be held at Cornell University, July 12-23 inclusive, will review aspects of machine tool selling from both close and long range. The course will be conducted by the Sibley School of Mechanical Engineering in cooperation with the American Machine Tool Distributors' Association.

Leaders of industry and education will discuss 47 different sales engineering topics during the two-week course. Harry J. Loberg will be director of the course; Daniel R. Weedon will be chairman of the National Machine Tool Builders Committee. Cornell faculty members, sales executives from the machine tool industry and customers experienced in the purchase and application of machine tools will comprise the faculty for the course.

FOR SALE

One Hydraulic Power Unit equipped with 2 intensifiers, 2 gpm pumps and valves for testing pressures up to 10,000 psi. Complete equipment $850.00 F.O.B. Memphis, Tennessee. Write Box 457 care APPLIED HYDRAULICS.

Basic Hydraulics

The Standards and Curriculum Division, Training Bureau of Naval Personnel. 314 pages, 9 x 6 inches. For sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C. at $1.50.

Although this book was primarily written for use in United States Naval Gunner's Mate Schools which provide courses in basic hydraulics, it should prove valuable to beginners in industry. An effort has been made to not only explain how the hydraulic systems work but to also describe their construction. There are no mathematical explanations and very few formulas. Wherever possible the principles involved have been shown to be consistent with everyday knowledge and experience. Fourteen chapters deal with all phases of hydraulics and describe in detail the construction and operation of the most common types of components and accessories. The introductory chapter is very good and persons with very limited knowledge of the subject will find it helpful—it covers: development of hydraulics; properties of liquids; relations of pressure and force and simple applications of hydraulic principles. Schematic drawings and illustrations are used throughout the book and at the end of each chapter several questions relating to the subject material are included. Plant maintenance men and operating engineers who wish to improve their knowledge of hydraulic principles will find this book valuable and informative.

PERSONALS

STEPHEN J. ZELLE recently joined The Bridgeport Safety Emery Wheel Co., Inc., Stratford, Conn. as chief engineer.

CHARLES R. COLLINS, vice president in charge of sales and advertising of the Gerotor May Corporation, Baltimore, Md., has been re-elected vice president of the Oil Heat Institute of America. The balloting took place during the recent OHI Silver Anniversary Exposition at the Palmer House, Chicago.

Mr. Collins

LAWRENCE B. RICHARDSON, formerly vice president of the Curtiss-Wright Corp., has been elected president of the Fairchild Engine & Airplane Corp. to succeed J. Carlton Ward, Jr. Mr. Ward was named chairman of the board.

JAMES M. WHITE, formerly vice president in charge of manufacturing at Allis-Chalmers Mfg. Co., Milwaukee, has joined the Allen-Bradley Co., of the same city. He will serve on the production management staff.

A. E. W. JOHNSON, for thirty-one years engaged in engineering and development work for the International Harvester Co., has recently been appointed director of engineering for the entire company. He began as a draftsman in 1916 and advanced through numerous engineering jobs until his appointment as manager of implement engineering in 1940. In 1944 he became manager for the farm implement division.

A. KING MC CORD has been promoted from vice president-operations to first vice president of The Oliver Corporation, Chicago. O. E. Eggen, director of engineering, and R. E. Melvin and C. L. Hecker have also been elected vice presidents.

JAY CRESWELL, president of Pneumatics Incorporated, Plymouth, Indiana, has recently purchased all of the capital stock of Anker-Holth Manufacturing Co., Port Huron, Michigan, from Lillian R. Berkenstein and her associates. Creswell, manufacturer of air cylinders and valves for a number of years, acquired the Anker-Holth business in order to add hydraulic cylinders, mill type cylinders, rotating cylinders, chucks and additional air valves to products now offered. The present distributing organizations will be maintained and new distributors, sales agents and sales engineering representatives will be added in territories now not served.

JAMES WILSON has retired as manager of the field engineering section of the steam turbine department, Allis-Chalmers Mfg. Co., Milwaukee after 43 years' service. John R. Queen, for the last 2 years texrope sales representative in the New York district office, has been named dealer supervisor at the same office.

HOWARD M. HUBBARD has been appointed president of The Hydraulic Press Mfg. Company, Mount Gilead, Ohio, according to an announcement by the board of directors. He will replace H. A. Toulmin, Jr. who resigned last November. Hubbard has served as president of several nationally known organizations and comes to The Hydraulic Press Mfg. Company after three years as a consulting and development engineer.

Mr. Hubbard

DONALD J. NAUMANN, formerly chief engineer for Brown Aircraft Co., Montebello, Calif., is now associated with North American Aviation, Inc., Inglewood, Calif., as a designer on confidential projects.

FRANK M. SMITH has been appointed comptroller of Rack Engineering Co., Pittsburgh.

DR. JOHN A. HUTCHESON has been appointed to succeed Dr. L. Warrington Chubb as director of the Westinghouse Research Laboratories, East Pittsburgh. Dr. Chubb is retiring from active direction of the laboratory, but has been named emeritus director and will continue in an advisory capacity.

ROBERT H. MC GRATH has been appointed assistant to Tell Berna, general manager of the National Machine Tool Builders' Association, Cleveland, Ohio. McGrath was formerly vice president and general manager of Joseph Dyson & Sons, Inc., Cleveland.

O. G. SCHWENK has been appointed assistant to the president, The Weatherhead Co., Cleveland. R. J. Finnegan has been appointed general production manager, the position vacated by Schwenk.

CHARLES W. YOUNG has been appointed plant manager of the Pennsylvania Flexible Metallic Tubing Co., Philadelphia. He has been associated with the company for over twenty years.

OSCAR A. AHLERS has been elected a vice president of The Sheffield Corp., Dayton. He has been a member of the Sheffield organization for 23 years.

H. J. SPRECHEN, SR., superintendent of automotive foundries, International Harvester Co., Chicago has retired after serving with the company since 1922.

ROYAL A. STONE has recently been appointed chief engineer for the eastern division of H. K. Ferguson Co. He will make his headquarters in New York.

GEORGE R. FRANKLAND has been appointed Chicago district manager of the industrial products division of Johns-Manville Corp.

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HYDRAULIC CYLINDERS
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All Accessories for Complete Systems

1001 SAVING ADAPTATIONS For Pulling, Pushing, Pressing, Lifting, Tilting, Turning, Squeezing, etc. operations. Finest precision workmanship. Aircraft alloy of aluminum and chrome steel, guaranteeing trouble-free operation. Liquid and/or air operation, developing terrific power.

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PNEUMATIC TOOLS
RIVET GUNS AIR MOTORS DRILLS

ALL POPULAR MAKES

#181 Pistol
E3, E2, 3X, 2X, 0Y
$55 Value
#180
$8.95

Complete with #196 1/4" JCB Chuck, 2500 R. P. M.
$65 Value
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